

EXHIBIT J

Page 2

1 UNITED STATES DISTRICT COURT
2 NORTHERN DISTRICT OF CALIFORNIA
3 SAN FRANCISCO DIVISION
4
5
6 IN RE PACIFIC FERTILITY)
7 CENTER LITIGATION,) Case No. 3:18-cv-01586-JSC
8)
9
10
11
12
13 VIDEOTAPED & VIDEOCONFERENCED DEPOSITION OF
14 FRANKLIN K. MILLER, Ph.D., taken on behalf of Plaintiffs
15 remotely beginning at 9:32 a.m., Monday, December 14,
16 2020, before CHERREE P. PETERSON, RPR, CRR, Certified
17 Shorthand Reporter No. 11108.
18
19
20
21
22
23
24
25

Page 3

1 A P P E A R A N C E S
2
3 FOR THE PLAINTIFFS:
4 GIBBS LAW GROUP LLP
5 505 14th Street, Suite 1110
6 Oakland, California 94162
7 BY: AMY M. ZEMAN, ESQ.
8 (510) 350-9700
9 amz@classlawgroup.com
10
11 FOR THE DEFENDANT CHART INDUSTRIES, INC.:
12 SWANSON, MARTIN & BELL, LLP
13 330 N Wabash, Suite 3300
14 Chicago, Illinois 60611
15 BY: JOHN J. DUFFY, ESQ.
16 KEVIN M. RINGEL, ESQ.
17 (312) 321-9100
18 jduffy@smbtrials.com
19 kringel@smbtrials.com
20
21 THE VIDEOGRAPHER:
22 PHILIP KNOWLES
23
24
25

Page 4

1 I N D E X
2
3 EXAMINATION BY: PAGE
4 MS. ZEMAN 6
5
6
7 E X H I B I T S
8
9 PLAINTIFFS' EXHIBIT NO. DESCRIPTION PAGE
10 440 December 4, 2020, Rebuttal Report Of Franklin K. Miller, Ph.D., (12 Pages) 6
11 441 December 11, 2020, Rebuttal Report Of Franklin K. Miller, Ph.D., (19 Pages) 70
12 442 "Nitrogen Adsorption Isotherms For Zeolite And Activated Carbon" Paper By L.C. Yang, T.D. Vo, And H.H. Burris, (10 Pages) 75
13
14
15
16
17
18
19
20
21
22
23
24
25

Page 5

1 DECEMBER 14, 2020
2 ---oOo---
3 BE IT REMEMBERED that set on Monday, the 14th
4 day of December, 2020, commencing at the hour of 9:32
5 a.m., taken remotely before me, Cherree P. Peterson,
6 RPR, CRR, CSR No. 11108, a Certified Shorthand Reporter,
7 personally appeared
8 FRANKLIN K. MILLER, Ph.D.,
9 having been called as a witness by the plaintiffs, who
10 having been duly sworn by me to tell the truth, the
11 whole truth, and nothing but the truth, was thereupon
12 examined and testified as hereinafter set forth.
13 ---oOo---
14 THE VIDEOGRAPHER: Good morning, Counsel. My
15 name is Philip Knowles. I am the host and videographer
16 associated with Barkley Court Reporters located at 201
17 California Street, Suite 375, in San Francisco,
18 California 94111. The date today is Monday, December
19 14th, 2020, and the time is approximately 9:33 a.m.
20 Pacific Standard Time.
21 This deposition is taking place remotely via
22 Zoom in the matter of Pacific Fertility Center
23 litigation with case number 3:18-CV-01586-JSC. This is
24 the videotaped deposition of Dr. Franklin K. Miller
25 being taken on behalf of plaintiffs.

Page 6

1 Will counsels for the parties please voice
2 identify themselves.
3 **MS. ZEMAN:** This is Amy Zeman on behalf of the
4 plaintiffs.
5 **MR. DUFFY:** John Duffy on behalf of Chart.
6 **MR. RINGEL:** Kevin Ringel also for Chart.
7 **THE VIDEOGRAPHER:** Thank you. The court
8 reporter may now answer in the witness and make a
9 statement for the record.
10 **THE REPORTER:** Raise your right hand, please,
11 Doctor.
12 (Whereupon the witness was placed under oath.)
13 **THE REPORTER:** Thank you.
14 **EXAMINATION BY MS. ZEMAN**
15 Q. Good morning, Dr. Miller. Good to see you
16 again. Thank you for joining us.
17 **A. Good morning.**
18 Q. I will try not to take up too much time of your
19 day today, but I do have a few questions about the two
20 reports you've put in since we spoke last.
21 For starters, I would like the [Exhibit 440](#) to
22 be entered and made available to you. That will be your
23 rebuttal report dated December 4th of 2020.
24 (Plaintiffs' [Exhibit 440](#) marked for
25 identification.)

Page 7

1 **MS. ZEMAN:** Philip, are you going to?
2 **THE VIDEOGRAPHER:** Yeah. Amy, what I did with
3 Dena last week was I made it, and then I saved it, and
4 then I sent it back into the chat, and then I screen
5 shared. Would you like me to do the same thing?
6 **MS. ZEMAN:** All but the screen share.
7 **THE VIDEOGRAPHER:** Okay. And you know what,
8 that makes sense. I didn't screen share for Dena. So
9 sorry, guys. It just takes a second to save it. And
10 sorry for all the unnecessary commentary, Cherree.
11 Okay. [Exhibit 440](#) is available for download.
12 Q. BY MS. ZEMAN: Dr. Miller, if you could
13 download that and take a look at it and let me know if
14 you recognize the document.
15 **A. Yes, I recognize the document.**
16 Q. Okay. And what is this?
17 **A. This is my December 4th rebuttal report.**
18 Q. Okay. Great. And I don't think I have a
19 question on it directly right away. But if at any point
20 during my questions if you want to refer to that, you
21 are welcome to do so. And there will be times when I do
22 refer to specific references in that report.
23 **A. Okay.**
24 Q. Dr. Miller, does metal contract when it is
25 cooled?

Page 8

1 **A. Yes, it does.**
2 Q. Is that a basic concept a trained engineer
3 would understand?
4 **A. Yes, it is.**
5 Q. Do you need to do any testing to know that
6 metal contracts when it is cooled?
7 **A. You -- well, it's a bit complicated. You would**
8 **-- someone has to do testing to know how much metal**
9 **contracts. There are tables of values for equations**
10 **that are used to describe the quantity or the amount**
11 **that metal contracts when it changes temperature. So --**
12 Q. You mean -- go ahead.
13 **A. So if you want to know that metal contracts,**
14 **no, you don't have to know -- do a -- do a test. But**
15 **there are some materials that contract and expand as**
16 **they go down in temperature, as I have direct experience**
17 **with that. Some materials get shorter and then when**
18 **they get to a certain temperature they start getting**
19 **longer again. But that's not specifically metal.**
20 **So you could know it would contract, but you**
21 **couldn't quantify how much unless you have test data**
22 **from someone or from a handbook from tables. And that**
23 **contraction is a function of the temperature.**
24 **Metal does not contract the same amount at room**
25 **temperature per degree of temperature change as it**

Page 9

1 **contracts at low temperature per degree per temperature**
2 **change. So that's a temperature-dependent material**
3 **property.**
4 Q. Dr. Miller, does metal expand when it is
5 warmed?
6 **A. Yes, it does.**
7 Q. Is that a basic concept a trained engineer
8 would understand?
9 **A. Yes, it is.**
10 Q. If the metal at a joint expands or contracts do
11 basic engineering principles dictate that the joint will
12 experience stress?
13 **A. Actually, no, the joint will not experience**
14 **stress if the temperature changes at a joint. If the**
15 **entire joint changes temperature uniformly at the same**
16 **time, there will be a change in the dimension of the**
17 **material but no stress as a result of that change.**
18 Q. And that example that you just described, that
19 would be if all of the parts at the joint are free to
20 expand; correct?
21 **A. It has nothing to do with free to expand. If I**
22 **take a piece of metal and I uniformly change its**
23 **temperature from room temperature to cryogenic**
24 **temperature and do it in a manner that there's no**
25 **appreciable difference in temperature between one part**

Page 10

1 of that and another, there will be no stress induced,
2 thermally induced stress in that part.

3 Q. Does that apply if there are different types of
4 metal involved in the joint?

5 A. If there are different types of metal involved
6 in some buildup -- when you say by joint, if something
7 is welded then it's relatively uniform in composition.
8 There are rare cases where we do weld copper to
9 stainless steel, those kind of joints. Those are very
10 rare though.

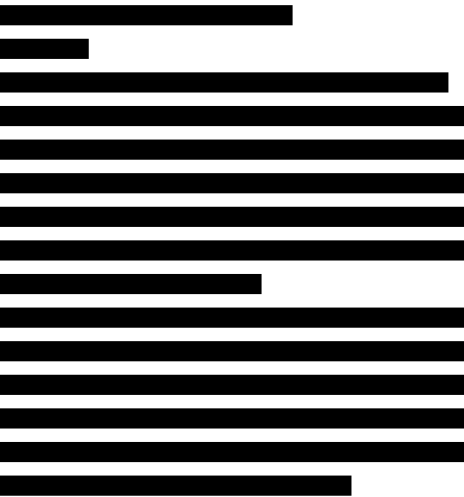
11 But generally speaking if you have a welded
12 part, that joint is uniform -- relatively uniform
13 composition. In -- we often do calculations in
14 cryogenics where we have stack ups of parts when we go
15 cold. For instance, we may have copper or brass flanges
16 bolted together by stainless steel screws. And when we
17 go cold, we like to assure that they're getting tighter,
18 not looser. And in that case one material contracts at
19 a different rate than another one. And often what we'll
20 do is use brass screws with copper flanges because their
21 coefficients of thermal expansion are very similar
22 versus something like stainless steel.

23 And then there are ways to compensate that we
24 -- and part of cryogenic design is to use Invar washers,
25 Bellville washers that are spring washers to take up

Page 11

1 that slack.
2 So yes, you can have changes in dimensions with
3 the same temperature, but that's because the composition
4 of the material is significantly different and has a
5 different material property behavior.

6



Category	Value (approximate percentage)
6	100
6	95
6	60
6	25
6	90
6	100
6	95
6	98
6	90
6	95
6	55
6	90
6	95
6	95
6	95
6	95
6	70
6	85
6	95
6	90

Page 14

[REDACTED]

Page 16

1 the bottom of the tube would not be at liquid nitrogen
2 temperature.
3 But if the tank was operating in its normal
4 operating manner with liquid nitrogen, then the bottom
5 end of the tube at the liquid level, however far the
6 liquid level is in the tank, that would be at liquid
7 nitrogen temperature. And the place where the tube goes
8 through the wall, the top would be near room
9 temperature.
10 Those are just -- they're assumptions because I
11 didn't measure them every day. But that -- those are
12 very reasonable -- it's a reasonable assessment of the
13 condition, the boundary conditions for the tank when it
14 was getting ready to fill.
15 Q. What's room temperature in the PFC lab where
16 Tank 4 was kept for six years?
17 A. I cannot know that exactly. But that -- if
18 there was a slight difference in the room temperature,
19 it would have a minimal effect on the calculation.
20 Q. But your calculation is based on assumptions
21 about the temperature, not the actual temperature that
22 the Tank 4 fill line was subjected to; correct?
23 A. For the cold-end temperature, it's pretty much
24 absolute dead on. For the warm-end temperature it's
25 within 5 degrees C unless they are running their lab at

Page 17

2 Q. Both your upper bound and your lower bound are
3 estimates; correct?
4 A. I don't know that I would call them an
5 estimate. How can I put this? An estimate would often
6 have an error or a possible error that goes above and
7 below.
8 In this case what I've done is the actual
9 temperature profile in the tube falls somewhere in
10 between these two extremes. And so what I've done is
11 set an upper limit and a lower limit on the possible
12 length change. So it's -- it's they're limiting --
13 they're limits. They're upper and lower limits. The
14 actual contraction falls between these two limits.
15 Q. But you've established some assumptions and
16 then calculated out what you considered to be the upper
17 and lower bounds. And those are not the actual values
18 for Tank 4 in operation; correct?
19 A. That is not correct. The tank, Tank 4 -- now,
20 I have to assume that Tank 4 was operating in a
21 condition where it had liquid nitrogen inside the tank,
22 and then I have to assume that the -- it's in a room
23 that's near room temperature. So there are assumptions
24 from that perspective that, you know, if the tank was
25 filled with something besides liquid nitrogen, then no,

1 a very uncomfortable temperature for workers.
2 Q. Are your upper and lower bounds based on actual
3 temperature measurements of Tank 4 in use?
4 A. Obviously not because I was -- nor was anyone
5 -- the temperature of a room can change by a few degrees
6 over the course of a day, over the course of weeks. But
7 the temperature of the room would be some number that's
8 within the range -- within a small range of the number
9 I've used.
10 [REDACTED]

[illegible]

Page 22

[REDACTED]

[REDACTED]

10 Q. What is the warmest the insulation would be in
11 those circumstances?

12 A. Which point? Where on the insulation?

13 Q. The warmest point.

14 A. I've done analysis for -- you'd have to take
15 every particular liquid level of the tank. And it would
16 be different for every one if you want a 3D temperature
17 profile of the insulation layers. You have to model it
18 using a Monte Carlo technique, which is what we did at
19 NASA, and you can -- you can get a temperature of the --
20 of the individual layers. You include residual gas
21 conduction, all these things.

22 But there's no way I can give you a temperature
23 of the insulation. The easy answer I guess is if you go
24 to the very top of the tank where the insulation touches
25 the outer wall at the very top of the neck, it will be

Page 25

[REDACTED]

1 basically room temperature. But that is -- that's just
2 -- that's a -- not a very useful answer, I guess.
3 So asking for a single number is not a useful
4 answer for thermal purposes. The inner layer where the
5 liquid nitrogen is, is very cold, almost liquid nitrogen
6 temperature. And each successive layer as you go out
7 gets warmer. It's not linear though. The outer layer
8 will be a lot closer to room temperature. And then 30
9 layers -- I cannot -- there isn't a good answer for
10 that.

11 Q. Over the course of -- oh, I'm sorry. Are you
12 done?

13 A. Go ahead. Yeah, it's a complicated
14 three-dimensional problem. And the temperature of the
15 outer layer of the MLI or the multilayer insulation is
16 irrelevant to what the temperature of the tube is
17 inside.

18 Q. Over the course of an MVE 808's lifetime is the
19 fill line subjected to different temperatures?

20 A. Yes. My analysis is based on that fact.

21 [REDACTED]

Page 26

[REDACTED]

Page 28

1 negligibly small changes.

2 Q. And so those small changes in the liquid level

3 would be also making small changes to the thermal

4 profile of the fill line; correct?

5 A. Incredibly small. Because the -- any

6 significant change would come from a fill event. The

7 liquid level only changes appreciably during a fill

8 event because you can't create or take away liquid

9 quickly. So liquid boils off slowly. That's part of

10 the cycle; right? Liquid level goes down. That's part

11 of the cycle. And then you replace it. And that's a

12 cycle. That's one full cycle. One full thermal cycle.

13 So, you know, any small changes are going to be

14 incredibly tiny compared to -- the fill event is the

15 event that's the game changer here because the

16 temperature profile changes in the tube when it's

17 sitting there are incredibly small compared to the

18 temperature profile change when you shock this thing

19 with liquid nitrogen.

20 You bring in a fill of liquid nitrogen, the

21 entire length of the tube goes from being this

22 temperature profile. It shrinks by 23,000ths. And

23 that's what goes into the analysis because that's the

24 event that brings about the thermal length change we're

25 talking about, not little tiny changes in the liquid

[REDACTED]

2 Q. And in a tank in normal usage in an IVF lab,

3 the portions of the fill line with and without liquid

4 nitrogen present versus with gaseous nitrogen present

5 would change constantly; correct?

6 A. Can you restate the question?

7 Q. In an MVE 808 that's in use in an IVF lab, so

8 being used to store samples with liquid nitrogen present

9 and being replenished regularly, would the portion of

10 the fill line with and without liquid nitrogen present

11 be in constant flux?

12 A. Okay. I think I understand what you're saying.

13 So if samples were inserted and samples taken out, there

14 would be some small change in the liquid level. Okay?

15 But not very much. And then when the tank is filled --

16 so if it was at 11 inches and then it was filled to 14

17 inches, yes, the level in that tube would change. And

18 so it would -- a longer portion of the tube would then

19 be cold.

20 However, there's only -- it doesn't

21 significantly change the assumptions. If the level is

22 now at 14 inches, less of the tube is subjected to

23 thermal change. So yeah. So there would be small

24 changes in the liquid level. I'm not saying there's

25 not. But with respect to what I've done here, those are

Page 29

1 level.

2 Because there's not enough of the tube involved

3 to cause major length change like there is in these fill

4 events. The fill events are 23,000ths in length change.

5 Q. Liquid nitrogen is constantly evaporating out

6 of an MVE 808 that's in use; correct?

7 A. Yes.

8 Q. And the rate of evaporation may vary, but it's

9 always burning off at some level; correct?

10 A. Yes, it is.

11 Q. When the lid is removed and the tank contents

12 are disturbed, the liquid nitrogen will evaporate

13 faster; correct?

14 A. Yes. The evaporation rate is dependent upon if

15 the lid's on or off.

16 Q. And based on your testimony within the last few

17 minutes, it sounds like you did not calculate for all of

18 the fluctuations for the entire life span of Tank 4's

19 fill line; correct?

20 A. The change -- so the fill event, the thing

21 that's a fill event. You consider a cycle for a fill

22 event -- includes liquid nitrogen. So if it's at 14

23 inches, level goes down to 11 inches, and then there's a

24 fill event. Okay? Then let's say some number of days

25 later liquid level goes down again, there's a fill

Page 30

1 event. That's all included in the analysis.

2 Q. But you didn't calculate the individual
3 temperature changes throughout that change from 14
4 inches to 11 inches; correct?

5 **A. I did not calculate the temperature profile for**
6 **each individual case, but I did calculate the worst-case**
7 **temperature profile such that in the normal operation**
8 **the temperature profile would be the warmest that it**
9 **would be, and then you would cool it to the coldest it's**
10 **going to be. So the excursions would be the maximum for**
11 **a normal operating condition for a fill.**

12 So I didn't -- I didn't have to calculate every
13 individual temperature profile because I calculated the
14 one that is -- where the temperature over the length of
15 the tube going from 11 to room temp -- 11 inches up to
16 room temperature is the worst that it would be. And
17 then it gets cold -- or the warmest it would be in
18 profile. It gets shocked or basically the liquid comes
19 in and it goes to the coldest it can be, which is the
20 liquid nitrogen temperature. And so that excursion in
21 length is the largest one you will see. Those changes
22 in length are the largest that you would see. Because
23 you want to look for the largest length change if you're
24 looking for cyclical failure.

25 Q. The fill tube line is 26 inches long; correct?

Page 31

1 A. The fill tube is approximately 26 inches long.

[illegible]

7 "fatigue lifetime." And this is again your March -- I'm
8 sorry -- your December 4th report. Can you tell me what
9 you mean by "fatigue lifetime"? And it's in the last
10 paragraph just before section --

11 A. Yeah. Yeah. I -- this is -- this is -- the
12 fatigue lifetime would mean the number of -- so, you
13 know, Mr. Parrington's going to do -- be the person who
14 really delves into this because this isn't my -- you
15 know, I know how to do the thermal analysis, the length
16 change analysis. I even know how to do stress analysis.
17 But I'm not a fatigue person. It's not what I do. It's
18 not my expertise. So this is information that I got.
19 Basically it's in conjunction with ESI and Mr.
20 Parrington.

21 I did provide the data from -- or the
22 references that give the fatigue strength, basically the
23 strain versus number of cycles to them. And I do know
24 from what I saw back on the peak strain values that it's
25 well below the number that allows you to have at least

Page 34

1 10,000 cycles. So it's well past that. It's less than
2 a third of that value.
3 And so that's what I'm saying is the results
4 that come from Parrington and ESI say that this is --
5 the cycle time would be -- the cycle life at these
6 extreme strains, meaning going from the initial
7 condition of the profiling the tank and considering that
8 the liquid level's at 11 inches and considering that you
9 go all the way to nitrogen temperature, that is the
10 cyclical load, the thermal cyclical load. That's the
11 cyclical load that happens with this tank. And if you
12 even have that, you know, cyclical load, the tank that
13 -- the failure, the fatigue lifetime is past the 10,000
14 that the graph goes to. It's beyond that.
15 But the details of that analysis are going to
16 be Ron Parrington's to deal with because I didn't do the
17 fatigue analysis. I'm just reporting based on this
18 result from his analysis.
19 Q. So this last paragraph before Section B on page
20 3, does that paragraph contain your opinions or Mr.
21 Parrington's?
22 A. It contains my opinions relevant to what this
23 means as far as the number of cycles. But it is based
24 on the results of the outcome of Parrington's analysis.
25 I did not do the analysis.

Page 35

1 Q. Do you intend to testify before a jury that the
2 fatigue lifetime of the fill port fitting to inner wall
3 weld is in excess of 10,000 cycles?
4 A. I intend to testify that I passed the results
5 of my thermal analysis to Ron Parrington, and the
6 results he gave back indicate that this is true because
7 that's the actual truth of how this went. I did the
8 thermal analysis. I knew what the boundary conditions
9 were. I passed that off to the thermal analysts -- I
10 mean, excuse me, the stress -- the FEA people. And they
11 did the results and got the results back. So that's the
12 extent of what I'll say about that.
13 Q. Do you intend to testify before a jury that
14 during the six years that Tank 4 was in service it was
15 subjected to approximately 2200 fill line thermal
16 cycles?
17 A. That is an approximate number. And yes, I'll
18 -- yes. It's approximate.
19 Q. What's your basis for that opinion?
20 A. That would be if it's filled once every other
21 day. Actually, that's once a day. Yeah, that's once
22 per day. And I don't think it actually was filled once
23 per day if you go back and look at the logs. It's not
24 filled once per day.
25 Q. Did you determine 2200 approximate fills

Page 36

1 through a calculation of your own?
2 A. Yes. Just by multiplying the number of days
3 times at most one cycle per day. So it's an
4 approximation. Go back through the data and show that
5 it's less than that.
6 Q. So you think that Tank 4 actually had less than
7 2200 fills?
8 A. It may have.
9 Q. Did you analyze the controller data to see how
10 many times a fill was initiated on Tank 4?
11 A. I didn't count them up.
12 Q. Did you analyze the controller data in any way
13 to see how many times a fill was initiated on Tank 4?
14 A. I didn't specifically analyze it for number of
15 fills.
16 Q. When you receive a cryogenic tank you purchase
17 from a vendor, do you examine the welds?
18 A. No. No. I actually usually don't. I do a
19 leak test on it however.
20 Q. Is that every single tank you obtain?
21 A. Yes. I'm working in a research environment.
22 So yes, we do a leak test on it. I've done it.
23 Q. So every time you obtain a new cryogenic tank,
24 you do a leak test on it before using it?
25 A. Let me -- let me say yes for the research

Page 37

1 dewars. For service dewars, no. No. If we have a --
2 you know, a liquid nitrogen dewar that we use for, you
3 know, transporting liquid from one place to another, no,
4 we don't check those. They're kind of off-the-shelf
5 items. But for the dewars that I use in-house, yes, I
6 check them. The ones for experiments.
7 MR. DUFFY: We've been going for about an hour,
8 Amy. Do you want to just take a five-minute break?
9 MS. ZEMAN: That sounds good.
10 MR. DUFFY: Thank you.
11 THE VIDEOGRAPHER: We are now going off the
12 record at 10:33 a.m. Pacific Standard Time.
13 (Whereupon a break was taken from 10:33 to
14 10:45.)
15 THE VIDEOGRAPHER: Okay. We are now going back
16 on the record. And the time is 10:45 a.m. Pacific
17 Standard Time.
18 [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

<p>Page 38</p> <p>[REDACTED]</p>	<p>[REDACTED]</p>
<p>[REDACTED]</p>	<p>[REDACTED]</p>

Page 45

23 Q. Do all of the tanks you work with outside of
24 this litigation break down so that you can see the welds
25 on the vacuum side?

1 A. Not all of them. But the one I'm thinking of
2 that isn't, it's closed out with a final weld where the
3 inner chamber is welded to the outer chamber. There
4 isn't a fill line on it -- that kind of fill line. So
5 the only way to close that out is to put a single-sided
6 weld on it. You can't weld the inside and the outside
7 after that.

8 So and the same is true for Chart. Some of
9 their welds, even if they wanted to do -- let's say they
10 decided they wanted to do double-side welds. For the
11 welds that put the tank together, there's no way to do
12 double-sided welds. You can't do them because you put
13 the tank together and then you seal it up. So yeah.

14 So I've been thinking of the tank that I have
15 for liquid nitrogen and liquid helium. That one is
16 closed out with a final weld at the top. That has to be
17 a single-sided weld. But have I verified every weld in
18 the thing? I do know that in the industry this is the
19 standard. Single-sided welds are the standard.

20 If you go to really large equipment like you
21 have at Fermilab, things like that, accelerators where
22 you have these high magnetic forces on components -- you
23 know, you have superconducting magnets that are enclosed
24 in, you know, liquid helium, super fluid liquid helium.
25 Some of those things have these skip welds on them

Page 46

1 because they're buttressing because they have very, very
2 high magnetic forces on them.
3 But in the kind of tanks we're talking about, I
4 haven't seen two-sided welds.
5 Q. Aside from any analysis done by Dr. Kasbekar in
6 this litigation, are you aware of any testing having
7 been done on the two-sided vacuum welds?
8 A. I am aware of the skip welds used in the -- in
9 the Fermilab experiments. I don't know of particular
10 testing, though, of double-sided welds.
11 Q. Have you searched for any such testing?
12 A. Well, I did -- I did do some searching because
13 I knew about the -- their -- you know, the large
14 equipment has -- you know, how do you weld on support
15 things with welds on each side? So I knew about that.
16 But I didn't run across any in my -- in my
17 search, but I don't know 100 percent that there's not --
18 you know, there could be somebody analyzed this and did
19 tests or whatever. I don't know.
20 But I do know in cryogenics classes when
21 learning this stuff in grad school one of the things
22 we're taught is don't use double-sided welds. There's
23 explanation why -- how to design weld preps or for these
24 seal welds as is -- you know, an example is the -- is
25 the MVE fitting that's machined down so that the two

Page 47

1 thicknesses are nearly similar.
2 So when I was in graduate school I designed all
3 single-sided welds with weld preps, went to a lot of
4 trouble to machine those pieces in a way that there
5 would be a similar thickness between them is part of
6 what I was taught and did.
7 Q. Are you saying you were specifically instructed
8 to not use double-sided welds on vacuum vessels?
9 A. Yes. By my Ph.D. advisor and my co-advisor.
10 Yes.
11 Q. Were those verbal instructions?
12 A. Yes. And this is what's taught in, you know,
13 cryogenics class. Yeah.
14 Q. Specifically people are told do not use
15 double-sided welds on vacuum --
16 A. Because of the potential of virtual leaks.
17 Q. Do you have any literature about that?
18 A. It is probably in some of the cryogenics texts
19 that I have.
20 Q. Is it in any of the literature that you relied
21 on for your reports?
22 A. It may be in the cryogenics texts that I relied
23 on for the latest report, the second rebuttal report.
24 But I didn't cite that particular -- I'm not sure if
25 it's in that text or not. I'll have -- I'm not sure

Page 48

1 it's in that text or not because that's a cryogenic heat
2 transfer text, not a general cryogenic engineering text.
3 Q. Did you ask if anyone at Chart has tested a
4 two-sided vacuum weld?
5 A. No, I didn't specifically ask them that
6 question.
7 Q. Have you reviewed any presale design acceptance
8 testing and validation of the single-sided weld used on
9 the MVE 808?
10 A. No.
11 Q. Are you aware of any such testing and
12 validation having been completed?
13 A. No. But there's a long history of field use
14 with these welds. So.... I think that this design
15 happened quite a while ago, and there's a long history
16 of these tanks being in the field with successful use
17 with a single-side weld.
18 Q. Do you recall at your prior deposition
19 referring to a tank manufactured by Janis that you were
20 or are currently using or about to use?
21 A. Yes. This was the tank that I said -- I think
22 I said -- I thought it was Janis. I don't know 100
23 percent for sure. But I think it's a Janis tank.
24 Q. Is that tank capable of being dismantled?
25 A. No. That's the one I just talked about that

Page 49

1 has the closeout weld on the top.
2 Q. And it does not have a fill line?
3 A. It does not have a -- it does not have a fill
4 line that penetrates into the inside space. It has some
5 tubes that penetrate through -- there's a quick cooldown
6 coil on it, but it doesn't have a tube that goes into
7 the inner space, no. It has a tube penetration through
8 the top that goes and there's a coil that wraps around
9 the tank, the inner tank, that you can use for --
10 Q. Does that tube connect to the inner vessel?
11 Does that tube connect to the inner vessel?
12 A. Not in the sense that it brings liquid into the
13 inner vessel. It's -- there's a tube wrapped around the
14 inner vessel that you can use if you're going to cool
15 down to liquid helium temperature, you can run liquid
16 nitrogen through that first to cool it down. But it
17 doesn't have a manual fill line as you would call it.
18 It's an annular heat exchanger is what it is.
19 Q. But at some point does it attach to the inner
20 vessel?
21 A. Physically, yes. Not on a fluid connection.
22 Q. It doesn't have an opening into the inner
23 vessel; correct?
24 A. Yes.
25 Q. Could water pass through a breach between two

Page 50

1 cold spaces if one space was at a slightly higher
2 pressure than the other space?
3 **A. I'm not sure what you -- how water relates to**
4 **this. Water would be in solid form in this particular**
5 **case.**
6 Q. That wasn't my question to this specific case
7 or to Tank 4 to liquid nitrogen. The question stands as
8 phrased.
9 **A. Could water pass through an opening from one**
10 **space to another if there's a pressure difference? Is**
11 **that the question?**
12 Q. Correct.
13 **A. Yes. That's what drives the flow is pressure**
14 **difference.**
15 Q. Could liquid nitrogen pass through a breach
16 between two cold spaces if one space was at a slightly
17 higher pressure than the other?
18 **A. Of course it could. What's really going to be**
19 **-- this is a different situation from water though. And**
20 **when you ask the water question, it really depends on**
21 **what the temperature is and what the pressure is.**
22 If you're getting at could liquid nitrogen pass
23 through and go into the vacuum space, it could. But it
24 would be a vapor when it got to the other side to the
25 lower pressure.

Page 51

1 Q. Did you say that it would be a vapor when it
2 got to the other side to relieve the pressure?
3 **A. No. That's not what I said.**
4 Q. Okay. My question is what did you say then?
5 I'm just trying to make sure I understood you correctly.
6 **A. The liquid would go -- when it -- in the**
7 **process of going from the high pressure to the low**
8 **pressure, it would vaporize.**
9 Q. Let me try again. I -- really, I honestly want
10 to know what the word was because it wasn't picked up in
11 the transcript. So I think you said something like, but
12 it would be a vapor when it got to the other side to
13 something the pressure. What's the word that you used?
14 **A. I'm not sure.**
15 Q. It might have been relieve? Does that sound
16 right?
17 **A. No, not relieve the pressure.**
18 Q. Or to release?
19 **A. No.**
20 Q. Okay.
21 **A. Because no, neither of those two words make**
22 **sense. Because of the reduced pressure? I don't know.**
23 Q. Okay.
24 **A. That actually makes sense. Because of the**
25 **reduced pressure. Because there's reduced pressure so**

Page 52

1 **it will flash and become vapor. But relieve and the**
2 **other word, that doesn't -- that doesn't work. Those**
3 **don't work.**
4 Q. But to reduce the pressure is an accurate
5 concept?
6 **A. No, not to reduce the pressure. It's because**
7 **of the reduced pressure. Yeah.**
8 Q. Okay. Thanks. In your opinion Tank 4 deformed
9 because the sieve material released nitrogen it had
10 previously absorbed; correct?
11 **A. That is correct.**
12 Q. And in other words, the sieve off-gassed
13 nitrogen and pressurized the vacuum space?
14 **A. Yes. As it warmed.**
15 Q. As the pressure increased in the vacuum space
16 as the sieve off-gassed, would the sieve had reabsorbed
17 some of the nitrogen?
18 **A. So the -- really wouldn't work quite that way.**
19 **There's an equilibrium that occurs between -- as the**
20 **temperature rises there's an equilibrium that occurs**
21 **which involves pressure, temperature to the pressure**
22 **over the getter or the vapor pressure over the top of**
23 **the getter, and the temperature related to one another.**
24 As that getter gets to 300 -- or, you know, up
25 near room temperature, there's very little gas that can

Page 53

1 remain inside the getter. There's a little bit, but
2 very little nitrogen gas will stay inside the getter at
3 that point. So I don't know that it really reabsorbs.
4 It's just there would be a little bit of gas that would
5 not come out of the getter, a minimal amount. Very few
6 of those little binding sites inside the liquid
7 nitrogen -- excuse me -- inside the getter would retain
8 nitrogen atoms -- or molecules, actually. Molecules.
9 So yeah, it's not really that it reabsorbs it. It just
10 reaches an equilibrium. An equilibrium.
11 [REDACTED]

[REDACTED]

<p>Page 54</p> <p>[REDACTED]</p>	<p>[REDACTED]</p>
<p>[REDACTED]</p>	<p>[REDACTED]</p>

Page 58

1 So I -- it really depends.
2 Q. What is the extremely valuable material that
3 you have firsthand experience overseeing the storage of?
4 A. Yeah, once again extremely valuable depends on
5 your -- but I had materials in dewars. And I don't know
6 that it was storage, but it was testing at low
7 temperature. And a failure of that dewar could have
8 destroyed the hardware that eventually flew on an x-ray
9 astrophysics mission. By the way, the mission -- that
10 spacecraft failure was on Japanese spacecraft that had
11 another kind of failure. But so they lost it anyway.
12 But that insert, those -- that cooler was worth -- to
13 rebuild it would have been multiple millions -- multiple
14 million dollars. I don't know exactly how much. But
15 that kind of hardware, I consider that very valuable.
16 Maybe that's not very valuable to some people, but to me
17 that was very valuable.
18 Q. Was it the dewar that was valuable to you or
19 the materials in that dewar?
20 A. The materials. The, you know,
21 one-of-a-kind-in-the-world cooler for space flight
22 mission. It cooled an x-ray detector for --
23 Q. So what were the materials that were extremely
24 valuable in that dewar?
25 A. Superconducting magnets, paramagnetic

Page 59

1 materials. Just the construction in the development of
2 that was, you know, years, decades in development at
3 NASA.
4 Q. Is there any other extremely valuable material
5 that you have firsthand experience in overseeing the
6 cryogenic storage of?
7 A. Well, I wouldn't -- I wouldn't -- once again,
8 I'm not saying cryogenic storage. But I'm saying
9 cryogenic -- you know, so it was cooled down and tested.
10 If there was some failure in the middle of the test, it
11 could have destroyed it. There were components for the
12 James Webb space telescope testing.
13 Q. To clarify, though, you are saying -- I'm
14 reading from your report at the top of page 5 where you
15 write "I have firsthand experience in overseeing the
16 cryogenic storage of extremely valuable material..., "
17 etcetera.
18 So my question is I'm trying to find out from
19 you what extremely valuable material is it that you have
20 had firsthand experience in overseeing the cryogenic
21 storage of? So so far you've identified superconducting
22 magnets and another related materials. You just
23 identified components for the James Webb telescope
24 testing.
25 Are there any other extremely valuable

Page 60

1 materials that you've had firsthand experience
2 overseeing this cryogenic storage of.
3 A. I think those are the most valuable ones. And
4 by storage, I mean, it's not storage in the sense that
5 it's sitting there actively doing nothing. But it's,
6 you know, cold temperature for weeks and we need to
7 maintain it. So it's more than storage. It's not just,
8 oh, we're dropping this in a tank and leaving it there.
9 It's we're doing testing at the same time. So it's more
10 than just storage.
11 Q. Do you want to amend the sentence in your
12 report to cover more than storage?
13 A. I don't know if storage and testing is relevant
14 to this case. I mean, you know, because there's not
15 cryogenic testing in this particular case.
16 Q. So you're saying only storage is relevant?
17 A. To this particular case.
18 Q. Okay. So is there any other extremely valuable
19 material that you've had firsthand experience in
20 overseeing the cryogenic storage of?
21 A. Let me think. The most valuable ones are the
22 James Webb and the x-ray mission hardware.
23 But as I said before, there are valuable things
24 here at the University. They're not at the same level.
25 You know, we're talking tens of thousands of dollars,

Page 61

1 not millions of dollars. So it's not the same.
2 Q. Do you have any firsthand experience overseeing
3 the cryogenic storage of human tissue?
4 A. I think I answered this in the last deposition.
5 No, I don't.
6 Q. Do you think embryologists have experience
7 working with cryogenic storage of human tissue?
8 A. Yes. Hope so.
9 Q. Do you think embryologists have experience
10 working with extremely valuable materials?
11 A. Yes.
12 Q. Do you consider yourself an ordinary user of
13 cryogenic tanks like the MVE 808?
14 A. That's a tough question because I'm sitting
15 here as a cryogenics expert. So of course I'm not an
16 ordinary user.
17 Q. Have you ever operated a cryogenic tank without
18 a controller?
19 A. Yes. In cases where I was just doing some
20 short-term testing and the material would tolerate
21 warming up. For the cases where we were talking about a
22 while ago where it's more expensive material, there is a
23 controller.
24 THE REPORTER: Amy, can you pause for just one
25 minute? I don't need to go off the record, I just need

Page 62

1 to plug something in real quick. Thank you. Thank you.
2 (Discussion off the record.)
3 **MR. DUFFY:** We're a little over an hour now.
4 **THE REPORTER:** Sure. Just two minutes?
5 **MR. DUFFY:** Yeah.
6 **THE VIDEOGRAPHER:** Off the record at 11:35 a.m.
7 Pacific Standard Time.
8 (Whereupon a break was taken from 11:35 to
9 11:46.)
10 **THE VIDEOGRAPHER:** We are now going back on the
11 record. The time is 11:46 a.m. Pacific Standard Time.
12 Q. BY MS. ZEMAN: Dr. Miller, how would systematic
13 checks and procedures ensure continuous and
14 uninterrupted function of a cryogenic tank?
15 A. Could you repeat the question? I'm sorry.
16 Q. Sure. How would systematic checks and
17 procedures ensure continuous and uninterrupted function
18 of a cryogenic tank?
19 A. If you maintain the regular checks and regular
20 -- of the tank, you'll know what's going on with it.
21 And if there are any problems, you can get them -- they
22 could be dealt with and serviced.
23 Q. So they won't necessarily prevent a tank from
24 malfunctioning, but they would allow the end user to
25 address the malfunction; is that correct?

Page 63

1 A. Yes. The tank could be -- you know, if there
2 was an alarm that wasn't working properly, if it's
3 regularly checked it could be corrected and prevent, you
4 know -- prevent there not being, you know, a control or
5 alarm or systems working.
6 Q. If you could look at the last sentence on page
7 4 of your December 4th report. And that sentence then
8 runs onto and ends at the top of page 5. And once
9 you've looked at that sentence, could you tell me who
10 you mean by the term "their ordinary users"?
11 A. People who work with cryogenic systems. You
12 know, in the -- in the world I worked in, not everybody
13 at NASA who uses cryogenic systems is a cryogenics
14 expert. They were people that I worked with who are
15 experts in other kinds of areas, optics experts,
16 materials experts. And they used cryogenic systems in
17 their -- in their work. And so I would call them
18 ordinary users of cryogenics systems.
19 They're not, you know, people who design
20 cryogenic systems. They're not people who build them.
21 They're not designing cryogenic systems. But it's part
22 of the work that they do, and they utilize cryogenic
23 tanks every day in their -- in their -- in the work
24 they're doing. So they would be ordinary users because
25 they're not -- they're involved in using cryogenics.

Page 64

1 They know how important it is. But it's something they
2 use, not something they're expert in. So that's my
3 definition of ordinary user.
4 Q. Is your definition of "their ordinary users"
5 everyone who utilizes cryogenic tanks?
6 A. I don't know if it's everyone who uses -- in
7 this particular context, I don't know if it's everybody
8 who uses cryogenic tanks. Some people use cryogenic
9 tanks to, you know, carry liquid nitrogen from one place
10 to another and fill a cold trap or cool down a device
11 that they use. They may have a cold station on an SEM
12 or something like that. There they use cryogenic
13 fluids, you know, for a particular use; but they're not
14 keeping some material at a cryogenic temperature, you
15 know, for a long time.
16 So I'm thinking of the person who's utilizing
17 cryogenics -- not necessarily a cryogenic expert, but
18 utilizing cryogenic environment for their testing, for
19 their storage, whatever it is. And they understand
20 cryogenic tanks and their use and what they're used for
21 and how they -- how they're important to the function of
22 their particular task.
23 So I don't just mean anybody who would pick up
24 a tank of liquid nitrogen and carry it over to the cold
25 trap, you know, and pour it in for their pumping system.

Page 65

1 That's a little different from someone who's tasked
2 with, you know, doing their work in a cryogenic
3 environment and have some material.
4 Q. How do you know that ordinary users view
5 cryogenic tanks as requiring systematic checks and
6 procedures to ensure continuous and uninterrupted
7 function?
8 A. Like I said, I've worked in an environment
9 where there were users of cryogenics, people who
10 characterize materials, did optics tests to cryogenic
11 temperatures, but were not cryogenic engineers. They
12 were ordinary users of cryogenic technology tanks,
13 vessels to carry out their tasks. But they certainly
14 understood.
15 That they may not have known how to revac a
16 system. They may not have known, you know, how to
17 design welds or how to build a tank or put out a
18 specification for a tank, but they did understand that
19 they needed to keep their material cold and that they
20 needed to check on it regularly and to have monitoring
21 for their tanks because they understood the value of
22 what was in there.
23 Q. Does measuring the liquid nitrogen in a tank
24 daily constitute a systematic check?
25 A. It is systematic in that if it's implemented

Page 66

1 properly, it's done daily. Is it sufficient, though, is
2 the question. If it's just measuring the level, it
3 doesn't --
4 Q. That wasn't my question. That wasn't my
5 question.
6 A. Measuring the level in a tank once per year is
7 systematic because it's done on a regular interval. But
8 it's not sufficient.
9 Q. Does topping off the liquid nitrogen in a tank
10 daily constitute a systematic check?
11 A. That depends on what's meant by topping off.
12 If it's -- a systematic check would mean there's a
13 measurement. So you would have to imply that in the
14 topping off there's a -- just coming by and pushing a
15 button and trying to top off the tank is not a
16 systematic check. That's a -- you could systematically
17 come by each day and push a button to top off a tank,
18 and that wouldn't necessarily be a check because there's
19 not a measurement involved. So I would say no, topping
20 off -- you'd have to measure too.
21 Q. Does topping off the liquid nitrogen in a tank
22 daily constitute a systematic procedure?
23 A. It's a systematic procedure if it's implemented
24 and it's carried out.
25 Q. Is it your opinion that the use of level

Page 67

1 control devices and remote alarms is required when using
2 cryogenic tanks?
3 A. Requiring -- required would carry with it the
4 implication that somebody's requiring it like a
5 governing body. And so is it required? It's certainly
6 prudent, and it's certainly advisable, and it really
7 depends on how much you value what's in the tank. If
8 you -- so I'm not sure "require" is the right word.
9 It's, you know, if you're willing to take the
10 risk of losing what's in the tank, then -- there's no
11 governing body in this situation that comes in and says
12 "You have to. You're required to have this."
13 There are -- you know, if you look at boiler
14 codes, there are, you know, safety valve requirements.
15 Low level water -- low level cutoffs alarms and
16 secondary backup cutoffs. Those are requirements
17 because they're required by the ASME boiler code and
18 implemented by the National Board of Boiler Inspectors.
19 In this case there is no such governing body. So it
20 really is how much risk do you want to assume.
21 Q. Does Chart require that its tanks be used with
22 level control devices and remote alarms?
23 A. I don't know how Chart would be able to
24 require. As I said before, there's no governing body
25 that requires this. I don't know how they would require

Page 68

1 someone to do that.
2 Q. Does Chart tell its customers or end users that
3 they must use a level control device or remote alarm
4 with their tanks?
5 A. I don't think so. They leave that -- the end
6 user has to decide how valuable the material is in the
7 tank and how -- to what extent and what level they need
8 to have monitoring in backup forms. These tanks are
9 used for a wide range of things, not just....
10 Q. On page 5 of your December 4th report you refer
11 to PFC's actions and inactions being extraordinarily
12 reckless under the circumstances. What circumstances
13 are you referring to?
14 A. The circumstances that they're storing
15 something valuable.
16 Q. That material is human tissue; correct?
17 A. Yes.
18 Q. Did you ask anyone who regularly uses cryogenic
19 tanks to store human tissue if Tank 4 fell short of
20 their safety expectations?
21 A. I didn't ask anyone who stores tissue. But I
22 think that that tissue is at least as valuable as the
23 materials that other people who I've worked with have
24 stored, and they expected to have alarm systems and
25 controllers on their systems.

Page 69

1 Q. What are safety expectations?
2 A. The expectation that the material you have in a
3 cryogenic environment will maintain integrity.
4 Q. Does that refer to safety expectations for the
5 materials stored in a tank?
6 A. Yes, for the safety of the material in the
7 tank. So procedures in place and monitoring in place to
8 meet those expectations.
9 Q. On page 5 of your report you refer to "Tank 4
10 did not fall short of the safety expectations....,"
11 etcetera. As you use safety expectations in that
12 sentence of your report, how is it defined?
13 A. Tank 4 was fully capable of maintaining
14 cryogenic temperature for the samples that were in place
15 as long as it was filled -- continued to be filled on a
16 regular basis with the liquid cryogen, with LN2. And so
17 in that sense it fulfilled the safety expectations.
18 It was the procedures and the lack of attention
19 to the tank that led to this, not -- not the tank itself
20 or its performance.
21 Q. You believe Tank 4 had a tiny leak prior to the
22 March 4th failure; correct?
23 A. I think it had a slow leak over possibly
24 several years, which is not unusual for a tank. And the
25 getter managed that leak in a way that allowed the tank

Page 70

1 to continue to perform its function, maintain insulation
2 integrity. And only when the tank liquid nitrogen level
3 went to zero did the vacuum level inside the tank rise.
4 And the implosion happened a day and a half later.
5 So yeah, the tank was capable of and did
6 maintain the safety of the tissue in there as long as it
7 was filled. But if the tank is not filled, it cannot
8 maintain cryogenic temperatures.
9 MS. ZEMAN: I would like to enter your rebuttal
10 report dated December 11th as Plaintiffs' [Exhibit 441](#).
11 Philip, could you circulate that, please.
12 THE VIDEOGRAPHER: Absolutely. Just bear with
13 me here.
14 (Plaintiffs' [Exhibit 441](#) marked for
15 identification.)
16 THE VIDEOGRAPHER: Okay. It's now loaded in
17 the chat.
18 Q. BY MS. ZEMAN: Dr. Miller, if you could take a
19 look at that exhibit and then let me know if you
20 recognize it.
21 A. Yeah, this is my report dated December 11th.
22 Q. In the second paragraph on page 5 of your
23 December 11 report you refer to a paper. Is that paper
24 the Yang and Burris paper titled "Nitrogen adsorption
25 isotherms for zeolite and activated carbon"?

Page 71

1 A. Second paragraph. Which page?
2 Q. Page 5.
3 A. Oh, okay. Second paragraph of the report.
4 Okay. Yes.
5 Q. That is the Yang and Burris paper that you're
6 referring to in that paragraph?
7 A. Yes.
8 Q. What do you mean when you write that "...the
9 paper included data for material at high pressure but
10 the data from the paper used for" your "analysis was
11 from low temperature and" low "pressure experiments..."?
12 A. Yeah. So they -- there's data in the paper for
13 78.9 kelvin approximately. That data is not at 300 psi.
14 If you -- there's a nondimensional graph in there. If
15 you take the data and you take it back to dimensional
16 form, the data is not from 300 psi. You don't do
17 adsorption data for nitrogen on zeolites.
18 And by the way, Siliporite is a brand name for
19 a zeolite made by, comma, trying to remember the name,
20 that is -- the reason in the last deposition I didn't
21 know what Siliporite is, in the cryogenics world it's
22 marketed as Cryo-Sieve. And then in the gas and oil
23 industry it's marketed under the brand name registered
24 trade name Siliporite. So there's a -- they're the same
25 material. They're a class of materials. It's not a

Page 72

1 particular material. They're synthetic zeolites.
2 And this paper Yang and Burris is a synthetic
3 zeolite. It is by a different manufacturer, but there's
4 not -- data at cryogenic temperatures is not done at 300
5 psi for this material. It's -- there is -- there is
6 data in the paper for 300 psi, but it's not for the
7 cryogenic temperatures. I mean --
8 Q. Wasn't that study done specifically to obtain
9 data covering higher pressures and temperatures?
10 A. Absolutely. Because a lot of -- some uses of
11 this material are for pressure swing adsorption, like if
12 you want to separate one species from another. There's
13 some cases where you can use this for nitrogen oxygen
14 separation. When....
15 THE REPORTER: You're cutting -- you're cutting
16 out just a little bit. There's some cases where you can
17 use this --
18 THE WITNESS: Okay. I'll slow down.
19 MR. DUFFY: No. I think it's actually just
20 your connection.
21 THE REPORTER: It's your -- it's your
22 connection.
23 MR. DUFFY: It's just starting to get a little
24 under water.
25 THE REPORTER: Right. Right.

Page 73

1 THE WITNESS: I'm on an Ethernet, but okay.
2 So these materials are also used to do pressure
3 swing adsorption which is where you raise the pressure
4 and one species preferentially adsorbs on the material.
5 You then pump out, and then you lower the pressure. And
6 you basically can separate one species from another that
7 way. So one gets adsorbed, you can pump out the other
8 species, and then you get a concentration of that
9 species.
10 So yes, they were doing measurements for those
11 applications, but they also made measurements at low
12 temperature. And I think one of the reasons is they
13 want to look at what the absolute capacity is at low
14 temperature for each of these binding sites. You know,
15 how many -- how many molecules can you get into this
16 material basically. How many N2 molecules can you get
17 into the material in a particular set of conditions.
18 So yes, at a cursory glance the paper is for
19 300 psi. But when you dig into the paper, there's data
20 there for low temperature. And it's -- it was useful, I
21 thought, because it had a -- it was -- there's not a lot
22 of data out there on these type of synthetic zeolites at
23 low temperature because they are often used for other
24 purposes.
25 Now, there's a difference of opinion here. Dr.

Page 74

1 Kasbekar thinks you can't use one brand for another, you
2 can't swap them out. I think it would be 10 percent.
3 I -- maybe even better than that. But that's okay. I
4 made a measurement to confirm that the tank -- the
5 getter will, in fact, hold as much gas as I thought it
6 would.
7 So yeah, if you read the paper carefully, if
8 you go in and take had the data that's on the graph,
9 take it from nondimensional form and put it back into
10 dimensional form, you'll see that it is at low pressure.
11 Q. BY MS. ZEMAN: There is some data in the paper
12 at low pressure. But it's more than a cursory glance;
13 correct? I mean, the paper was done because high
14 pressure adsorption data for a broad temperature range
15 are required to perform a quantitative system analysis;
16 correct?
17 A. Yes. But as a part of that analysis, they
18 did -- they did work at low temperatures.
19 Q. Sure.
20 A. So, you know, I was looking through papers for
21 data at this temperature. And this -- it was in there.
22 You know, some other papers had no low temperature data,
23 low pressure data.
24 Q. Where in the Yang and Burris paper is the data
25 for low temperature and pressure experiments?

Page 75

1 A. There's a graph.
2 MS. ZEMAN: Philip, could you enter the Yang
3 and Burris paper as [Exhibit 442](#).
4 THE VIDEOGRAPHER: Yes.
5 (Plaintiffs' [Exhibit 442](#) marked for
6 identification.)
7 THE VIDEOGRAPHER: Okay.
8 Q. BY MS. ZEMAN: Dr. Miller, if you could open up
9 [Exhibit 442](#) and let me know if that is the Yang and
10 Burris paper that you are referring to?
11 A. Yes, it is. So go to Figure 5.
12 MR. DUFFY: Franklin, would you just wait one
13 second. I want to make sure I'm catching up to you
14 guys. Hold on. Figure 5?
15 THE WITNESS: Figure 5.
16 MR. DUFFY: Thanks.
17 Q. BY MS. ZEMAN: Okay. So Figure 5 of the Yang
18 and Burris paper, is that the data on low temperature
19 and pressure experiments?
20 A. Not all the data is. Just the upward turn
21 triangles on the right-hand upper part of the graph. So
22 all of the data from 78.92 kelvin are up at the top of
23 that corner. And you can back out the pressure because
24 you have T log P s over P at the bottom. And P s is
25 given in here. It's this constant A minus 3.0630

Page 76

1 divided by T. And so because you know the temperature
2 is 78.92, you can back out what the pressure is. And
3 all these points are at low pressure. There's nothing
4 at high pressure for the 78.92.
5 Q. Okay.
6 A. That calculate what the pressure is. It's low
7 pressure. It's not -- it's not at high pressure.
8 Q. And is that data from Figure 5 the only data
9 you used from this paper?
10 A. Yes. I think so.
11 Q. Does this paper discuss desorption?
12 A. Does it discuss what?
13 Q. Desorption.
14 A. Desorption. No, I don't think so. It's --
15 they're adsorption isotherms is what. Why....
16 Q. Is it your opinion that the Cryosiev material
17 in the MVE 808 tanks releases 100 percent of the
18 molecules it's absorbed at room temperature?
19 A. It depends on the pressure that's in the tank.
20 It's probably about 5 percent that would stay in the --
21 in the sieve possibly, about 5 percent. That won't make
22 any difference in whether there's enough gas in there to
23 collapse the tank.
24 Q. And does this paper explain whether sieve would
25 release 95 percent of the molecules at room temperature?

Page 77

1 A. It explains it, but.... This particular paper
2 does not have room temperature data. But it does have
3 some 273 K data. And what you can see is that at one
4 atmosphere the delta M over M for this material, it's
5 .0064 grams per gram. Whereas the material would hold,
6 like, point one -- so it's in the third decimal place
7 the amount it will hold compared to -- what it will hold
8 at cryogenic temperature. And this is at 273, not at
9 293. So it will be even less than that. So it's like 6
10 percent. But if you go up to 290 kelvin, it's going to
11 be even less than that 6 percent.
12 Q. Where is the data that you're referring to now?
13 Is this Figure 5 or something else?
14 A. No. This is on page 629. And this is not
15 exactly the situation we have. I mean, it's.... So if
16 you look at T equals 273 at the top right-hand corner,
17 you see these numbers are changing over to the third
18 decimal place here at the modest pressures.
19 You know, a lot of the data is for higher
20 pressure, that is correct. But at the low pressure you
21 can see that it's over here at, you know, .0025 grams
22 per gram, .0047. And, you know, at 73 it's going hold
23 more than it would at 290-some kelvin.
24 Q. Does the adsorption of nitrogen and Siliporite
25 depend on pressure?

Response	Percentage
U.S. should take action	95%
U.S. should not take action	5%
U.S. should take strong action	90%
U.S. should take some action	5%

Page 82

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

12 MS. ZEMAN: I have no further questions.
13 THE VIDEOGRAPHER: Okay. Any follow-up, Kevin
14 or John?
15 MR. DUFFY: Yeah, no. We're good. We have no
16 questions. Thank you, Franklin.
17 THE VIDEOGRAPHER: This marks the end of the
18 remote deposition. We are going off the record at 12:30
19 p.m. Pacific Standard Time. Sorry. 12:36 p.m. Pacific
20 Standard Time. Thank you, Counsel.
21 (Whereupon the proceedings were concluded at
22 12:36 p.m.)
23 ---oOo---
24 //
25 //

Page 86

1 I have read the foregoing deposition
2 transcript and by signing hereafter, subject to
3 any changes I have made, approve same.
4
5 Dated _____.
6
7
8 _____
9 (Signature of Deponent)
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Page 87

1 DEPOSITION OFFICER'S CERTIFICATE
2 STATE OF CALIFORNIA }
3 COUNTY OF CONTRA COSTA } ss.
4
5
6 I, CHERREE P. PETERSON, hereby certify:
7 I am a duly qualified Certified Shorthand
8 Reporter in the State of California, holder of
9 Certificate Number CSR 11108 issued by the Certified Court
10 Reporters' Board of California and which is in full
11 force and effect. (Fed. R. Civ. P. 28(a)(1)).
12 I am authorized to administer oaths or
13 affirmations pursuant to California Code of Civil
14 Procedure, Section 2093(b) and prior to being examined,
15 the witness was first duly sworn by me. (Fed. R. Civ.
16 P. 28(a)(a)).
17 I am not a relative or employee or attorney or
18 counsel of any of the parties, nor am I a relative or
19 employee of such attorney or counsel, nor am I
20 financially interested in this action. (Fed. R. Civ. P.
21 28).
22 I am the deposition officer that
23 stenographically recorded the testimony in the foregoing
24 deposition and the foregoing transcript is a true record
25 / / /

Page 88

1 of the testimony given by the witness. (Fed. R. Civ. P.
2 30(f)(1)).
3 Before completion of the deposition, review of
4 the transcript [XX] was [] was not requested. If
5 requested, any changes made by the deponent (and
6 provided to the reporter) during the period allowed, are
7 appended hereto. (Fed. R. Civ. P. 30(e)).
8
9 Dated: December 15, 2020
10
11 _____
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Page 89

1 ERRATA SHEET
2 CHANGES IN TESTIMONY
3
4 PAGE LINE FROM TO
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

SIGNATURE OF WITNESS DATE

	added (1) 79:22	always (4) 21:23;29:9;32:24; 42:5	assessment (1) 16:12	29:16;34:17;23;39:21, 23:40:6
\$	adding (2) 18:16;22:6	amend (1) 60:11	associated (2) 5:16;40:14	basic (3) 8:2;9:7,11
\$30,000 (1) 57:12	additional (1) 82:21	amount (10) 8:10;24;12:16;13:1, 4:14;8;21:3;53:5;77:7; 85:8	assume (7) 14:1;15:20,22;18:19, 25:67;20;82:12	basically (9) 25:1;30:18;32:21; 33:19;22;42:21;73:6, 16:84:22
/	address (1) 62:25	Amy (5) 6:3;7:2;37:8;56:12; 61:24	assuming (5) 13:4;17:11,18,23; 55:10	basis (3) 35:19;69:16;84:23
// (2) 85:24,25	adsorbed (1) 73:7	analysis (32) 11:15;13:11;14:5,5; 20:17;21:25;24:14; 25:20;28:23;30:1;31:8, 13,17,20,25;33:15,16, 16:34;15,17,18,24,25; 35:5,8;46:5;54:21; 56:1,4;71:10;74:15,17	assumption (4) 11:17;13:22;17:20; 18:2	bear (1) 70:12
A	adsorbs (1) 73:4	analysts (1) 35:9	assumptions (7) 11:14,15;15:15,23; 16:10,20;27:21	become (1) 52:1
ability (1) 43:2	adsorption (7) 70:24;71:17;72:11; 73:3;74:14;76:15; 77:24	analyze (3) 36:9,12,14	assure (1) 10:17	begins (1) 25:22
able (3) 67:23;80:19;81:2	advisable (1) 67:6	analyzed (1) 46:18	astrophysics (1) 58:9	behalf (3) 5:25;6:3,5
above (3) 15:6;26:7,24	advisor (1) 47:9	annoyed (1) 55:5	Atlanta (1) 83:3	behavior (1) 11:5
absolute (2) 16:24;73:13	affect (3) 42:10,25;43:2	annular (2) 49:18;79:22	atmosphere (1) 77:4	belief (1) 40:5
Absolutely (6) 31:7;32:4;55:20,22; 70:12;72:10	affected (2) 14:2,14	answered (2) 61:4;81:4	atoms (1) 53:8	Bellville (1) 10:25
absorb (1) 79:1	afford (1) 57:20	apart (2) 38:10;44:11	attach (1) 49:19	below (3) 15:7;33:4,25
absorbed (2) 52:10;76:18	aftereffect (2) 84:17,24	appeared (1) 5:7	attached (1) 26:15	besides (2) 15:25;44:15
absorbs (1) 42:15	aftereffects (3) 83:9,22;84:3	applications (1) 73:11	attention (1) 69:18	best (1) 39:7
accelerators (1) 45:21	again (12) 6:16;8:19;19:14; 21:13;29:25;32:21,22, 22;33:7;51:9;58:4;59:7	appreciable (1) 9:25	auto (2) 26:15;33:1	better (2) 56:9;74:3
acceptance (1) 48:7	against (2) 20:2;23:19	appreciably (1) 28:7	automatically (1) 33:2	beyond (1) 34:14
access (3) 80:13;81:17,17	ago (2) 48:15;61:22	approximate (4) 31:4;35:17,18,25	available (2) 6:22;7:11	big (1) 12:9
accessible (1) 38:15	ahead (3) 8:12;25:13;79:4	approximately (5) 5:19;23:12;31:1; 35:15;71:13	aware (5) 46:6,8;48:11;83:4; 85:4	bigger (4) 53:20;54:9,10,12
account (3) 79:21,23;85:2	air (2) 26:8,17	approximation (3) 36:4;56:8,9	away (2) 7:19;28:8	biggest (3) 55:9,10,10
accounting (1) 14:5	airport (1) 83:2	area (2) 20:20;21:6	axis (1) 11:19	binary (1) 56:23
accounts (1) 55:1	alarm (4) 63:2,5;68:3,24	areas (1) 63:15	B	binding (2) 53:6;73:14
accurate (1) 52:4	alarms (3) 67:1,15,22	Arkema (1) 78:10		bit (5) 8:7;22:7;53:1,4; 72:16
across (1) 46:16	alleviate (2) 43:14,16	around (3) 42:6;49:8,13	back (21) 7:4;18:23;31:24; 32:19;33:24;35:6,11, 23;36:4;37:15;40:11, 14;54:24;57:8;62:10; 71:15;74:9;75:23;76:2; 81:13;82:20	blanket (2) 19:24;20:8
actions (1) 68:11	allow (2) 43:9;62:24	Aside (1) 46:5	backup (2) 67:16;68:8	Board (1) 67:18
activated (1) 70:25	allowed (1) 69:25	ASME (1) 67:17	bar (1) 20:24	body (4) 67:5,11,19,24
actively (2) 26:2;60:5	allows (1) 33:25		Barkley (1) 5:16	boiler (3) 67:13,17,18
actual (10) 13:8;15:8,14,17; 16:21;17:2;31:22;35:7; 84:5,14	almost (2) 25:5;54:15		based (9) 16:20;17:2;25:20;	boiling (1) 22:21
Actually (16) 9:13;20:14;35:21,22; 36:6,18;38:2;39:11; 51:24;53:8;55:3;72:19; 81:24;83:7,19;84:6	along (4) 11:19;14:23;20:21; 54:13			boil-off (1) 81:25
	alternate (2) 18:24;19:14			boils (1) 28:9
				bolted (2) 10:16;44:5

Both (1) 15:2	74:24;75:3,10,18	64:9,24;65:13;67:3	checks (4) 62:13,16,19;65:5	71:19
bottom (14) 14:10,10,19;16:1,4; 18:15;21:19;23:1,4,4,6, 9;32:15;75:24	busy (1) 82:11	case (20) 5:23;10:18;13:12,14; 15:8;17:17;26:14,16; 30:6;39:21;44:4,4; 50:5,6;60:14,15,17; 67:19;82:15;84:11	Cherree (2) 5:5;7:10	commencing (1) 5:4
bound (24) 11:6,10,11;12:17,18, 25;13:2,7,8,14,16; 14:24;15:2,2;17:17,21; 18:19,24;19:15,15,18, 18;20:19;78:24	button (2) 66:15,17	cases (9) 10:8;22:3;61:19,21; 72:13,16;78:23;84:4,8	chose (1) 13:9	commentary (1) 7:10
boundary (5) 15:1,1;16:13;21:8; 35:8	buttrressing (1) 46:1	catch (1) 82:19	circulate (1) 70:11	communication (1) 13:20
bounded (1) 17:25	C	catching (1) 75:13	circumstances (4) 24:11;68:12,12,14	compared (3) 28:14,17;77:7
bounding (1) 13:14	calculate (11) 29:17;30:2,5,6,12; 31:3;54:4,21,22;55:12; 76:6	cause (1) 29:3	cite (1) 47:24	compensate (1) 10:23
bounds (4) 13:9,12;15:17;17:2	calculated (5) 15:16;27:1;30:13; 31:3;32:11	caused (1) 83:5	cites (1) 83:16	completed (1) 48:12
boxes (1) 21:22	calculation (15) 11:13;16:19,20;18:2; 19:16;20:14,15;32:1,8; 36:1;53:12;54:2,8; 56:5;85:7	Center (1) 5:22	clarify (2) 59:13;84:2	completely (3) 13:19;31:20;55:11
bracket (1) 11:12	calculations (1) 10:13	certain (4) 8:18;42:22;55:20; 85:8	class (4) 47:13;54:16,17; 71:25	complicated (2) 8:7;25:13
brand (3) 71:18,23;74:1	California (2) 5:17,18	Certified (1) 5:6	classes (1) 46:20	components (3) 45:22;59:11,23
brands (1) 78:22	call (4) 15:4;43:11;49:17; 63:17	chamber (2) 45:3,3	classification (1) 78:11	composition (3) 10:7,13;11:3
brass (2) 10:15,20	called (1) 5:9	chance (1) 38:2	close (7) 11:18;12:12;19:24; 21:20;23:20;45:5; 81:24	concentration (1) 73:8
breach (2) 49:25;50:15	can (40) 11:2,14;12:19;15:5; 17:5;20:22;24:19,19, 22;25:23;27:6;30:19; 33:8;41:16;42:23; 44:16,24;49:9,14,15; 52:25;56:7,7;57:9,20; 61:24;62:21;72:13,16; 73:6,7,15,16;75:23; 76:2;77:3,21;78:14; 83:1;85:6	change (29) 8:25;9:2,16,17,22; 12:9,15;14:8,20;15:12; 17:5;20:21;27:5,14,17, 21,23;28:6,18,24;29:3, 4,20;30:3,23;33:16; 53:14;54:22;56:6	closed (2) 45:2,16	concept (3) 8:2;9:7;52:5
break (4) 37:8,13;44:24;62:8	candidate (1) 57:6	changer (1) 28:15	closeout (1) 49:1	concerning (1) 55:2
bring (1) 28:20	capable (3) 48:24;69:13;70:5	changes (18) 8:11;9:14,15;11:2; 14:17,18,23;26:17; 27:24;28:1,2,3,7,13,16, 25;30:3,21	closer (3) 20:5;22:21;25:8	concluded (1) 85:21
brings (2) 28:24;49:12	capacity (4) 42:4,12;73:13;85:9	changing (2) 54:11;77:17	co-advisor (1) 47:9	condition (10) 15:21;16:13;25:23, 24,25;26:2;30:11; 32:11;34:7;53:21
broad (1) 74:14	Carbide (1) 78:10	characterize (1) 65:10	code (1) 67:17	conditions (8) 13:4,15;15:1;16:13; 21:9;35:8;56:1;73:17
buckle (7) 80:9,10,12,15;81:10; 82:10;83:16	carbon (1) 70:25	Chart (15) 6:5,6;39:12,13,22; 40:2,7;45:8;48:3; 67:21,23;68:2;79:10; 81:15;82:18	codes (1) 67:14	conduction (1) 24:21
buckled (5) 81:3,5,6;82:6;83:12	career (1) 41:5	Chart's (1) 44:15	coefficient (8) 53:13,16,16,17,18, 19,24;54:3	confirm (3) 39:10;40:15;74:4
buckling (6) 80:6,22;81:9,12; 83:19,22	careful (1) 57:14	chat (2) 7:4;70:17	coefficients (1) 10:21	confirmed (3) 82:9,12;83:5
budget (2) 57:13,25	carefully (1) 74:7	check (9) 37:4,6;41:6;65:20, 24;66:10,12,16,18	coil (2) 49:6,8	conjunction (1) 33:19
build (2) 63:20;65:17	Carlo (1) 24:18	checked (1) 63:3	cold (17) 10:15,17;12:11;24:3, 5;25:5;27:19;30:17; 31:10;50:1,16;60:6; 64:10,11,24;65:19; 79:5	connect (2) 49:10,11
building (1) 40:2	carried (1) 66:24		colder (4) 12:1,1,2,2	connected (1) 26:12
buildup (1) 10:6	carry (4)		coldest (2) 30:9,19	connection (3) 49:21;72:20,22
built (1) 80:20			collapse (1) 76:23	consider (5) 13:18;29:21;56:10; 58:15;61:12
burning (1) 29:9			coming (1) 66:14	considered (1) 15:16
Burris (7) 70:24;71:5;72:2;			comma (1)	considering (2) 34:7,8
				constant (3) 21:7;27:11;75:25
				constantly (2) 27:5;29:5
				constitute (3) 65:24;66:10,22

construction (1) 59:1	count (1) 36:11	customers (1) 68:2	defined (1) 69:12	detector (5) 41:7,17;42:8,21; 58:22
contact (2) 11:18;14:21	couple (4) 22:5,6;44:9;83:8	cutoffs (2) 67:15,16	definite (1) 42:16	determine (5) 35:25;43:22;44:1; 53:12;54:1
contain (5) 26:5,8,10,11;34:20	coupling (1) 13:23	cutting (2) 72:15,15	definitely (1) 83:23	development (2) 59:1,2
contains (3) 21:11;22:10;34:22	course (6) 17:6,6;25:11,18; 50:18;61:15	cycle (11) 28:10,11,12,12,12; 29:21;31:9;34:5,5; 36:3;57:8	definition (2) 64:3,4	device (2) 64:10;68:3
contents (1) 29:11	Court (2) 5:16;6:7	cycles (7) 22:2,4;33:23;34:1, 23;35:3,16	deform (3) 83:6;84:6;85:5	devices (2) 67:1,22
context (1) 64:7	cover (1) 60:12	cyclical (10) 30:24;31:8,12,16,17; 33:5;34:10,10,11,12	deformed (4) 52:8;84:17,17,24	dewar (8) 26:13;37:2;57:7; 58:7,18,19,24;79:7
continue (1) 70:1	covered (1) 21:24	D	degree (4) 8:25;9:1;22:12,22	dewars (6) 37:1,1,5;58:5;83:10; 84:9
continued (1) 69:15	covering (2) 21:22;72:9		degrees (4) 16:25;17:5;22:15; 23:12	diameter (1) 20:23
continuous (3) 62:13,17;65:6	COVID (1) 38:2	daily (4) 65:24;66:1,10,22	delta (1) 77:4	dictate (1) 9:11
contract (6) 7:24;8:15,20,24; 13:1;14:25	create (1) 28:8	data (34) 8:21;33:21;36:4,9, 12;71:9,10,12,13,15, 16,17;72:4,6,9;73:19, 22;74:8,11,14,21,22, 23,24;75:18,20,22; 76:8,8;77:2,3,12,19; 78:1	delves (1) 33:14	difference (9) 9:25;12:4;16:18; 50:10,14;54:1;73:25; 76:22;79:3
contraction (6) 8:23;12:16;13:8; 15:14;53:12;54:10	critique (1) 53:20	date (1) 5:18	Dena (2) 7:3,8	differences (1) 78:12
contractions (1) 13:10	critiques (2) 53:11,23	dated (3) 6:23;70:10,21	density (1) 78:15	different (20) 10:3,5,19;11:4,5; 21:4;23:8;24:16;25:19; 26:20;50:19;65:1;72:3; 78:9,13,14,15,18,22,23
contracts (7) 8:6,9,11,13;9:1,10; 10:18	cross (2) 20:21,22	day (19) 5:4;6:19;16:11;17:6; 22:5;24:4;31:19,20,23; 33:1;35:21,21,22,23, 24;36:3;63:23;66:17; 70:4	depend (4) 20:19;57:1;77:25; 78:3	dig (2) 54:5;73:19
control (4) 63:4;67:1,22;68:3	cross-sectional (2) 20:20;21:6	days (3) 22:5;29:24;36:2	dependent (3) 21:5,7;29:14	dimension (1) 9:16
controlled (1) 82:8	CRR (1) 5:6	deal (1) 34:16	depends (13) 23:22;42:2,2,3,9,16; 50:20;57:20;58:1,4; 66:11;67:7;76:19	dimensional (2) 71:15;74:10
controller (4) 36:9,12;61:18,23	crumbled (1) 84:12	dealt (1) 62:22	deposition (9) 5:21,24;44:8;48:18; 61:4;71:20;83:8,24; 85:18	dimensions (3) 11:2;78:13,14
controllers (1) 68:25	crumpled (1) 84:13	decades (1) 59:2	describe (1) 8:10	dip (2) 82:1,2
cool (5) 30:9;31:19;49:14,16; 64:10	cryo (2) 42:15;54:18	DECEMBER (17) 5:1,4,18;6:23;7:17; 11:7;13:17;17:10; 25:21;33:8;63:7;68:10; 70:10,21,23;80:8; 81:12	described (2) 9:18;37:19	dipped (1) 82:23
cooldown (2) 31:14;49:5	cryogen (1) 69:16	decide (1) 68:6	design (7) 10:24;40:8;46:23; 48:7,14;63:19;65:17	dipping (1) 82:24
cooled (6) 7:25;8:6;31:10,23; 58:22;59:9	cryogenic (50) 9:23;10:24;36:16,23; 40:25;41:5;48:1,2; 59:6,8,9,16,20;60:2,15, 20;61:3,7,13,17;62:14, 18;63:11,13,16,20,21, 22;64:5,8,8,12,14,17, 18,20;65:2,5,10,11,12; 67:2;68:18;69:3,14; 70:8;72:4,7;77:8;85:3	decided (1) 45:10	designed (3) 11:21;40:13;47:2	direct (1) 8:16
cooler (3) 54:18;58:12,21	cryogenics (12) 10:14;46:20;47:13, 18,22;61:15;63:13,18, 25;64:17;65:9;71:21	decimal (3) 55:23;77:6,18	designing (1) 63:21	directly (1) 7:19
cools (1) 54:19	Cryosiev (2) 76:16;78:6	define (3) 11:6;13:16;25:23	desorption (3) 76:11,13,14	discuss (2) 76:11,12
copper (3) 10:8,15,20	Cryo-Sieve (1) 71:22		destroy (2) 57:25;81:10	Discussion (1) 62:2
corner (2) 75:23;77:16	CSR (1) 5:6		destroyed (3) 58:8;59:11;80:18	dismantle (1) 40:16
corrected (1) 63:3	currently (1) 48:20		destructively (1) 38:9	dismantled (1) 48:24
correctly (1) 51:5	cursor (2) 73:18;74:12		details (1) 34:15	dismantling (2) 43:23;44:2
cost (1) 57:22			detect (1) 43:2	distortion (1) 40:14
Counsel (2) 5:14;85:20			detection (1) 42:21	
counsels (1) 6:1				

disturbed (1) 29:12 divided (2) 76:1;80:1 Doctor (1) 6:11 document (2) 7:14,15 dollars (3) 58:14;60:25;61:1 done (15) 15:8,10;24:14;25:12; 27:25;36:22;46:5,7; 66:1,7;72:4,8;74:13; 80:16;84:9 double (4) 39:1;40:19;43:23; 44:2 double-side (1) 45:10 double-sided (9) 39:5,8,15;44:17; 45:12;46:10,22;47:8, 15 down (22) 8:16;11:25;14:7,19; 21:3;28:10;29:23,25; 31:10,20,24;42:22; 44:12,24;46:25;49:15, 16;54:19;56:15;59:9; 64:10;72:18 download (2) 7:11,13 Dr (14) 5:24;6:15;7:12,24; 9:4;11:6;37:18;46:5; 53:11;56:9;62:12; 70:18;73:25;75:8 drawing (5) 39:17,23;40:8;43:25; 44:3 drawings (1) 44:19 drives (1) 50:13 drop (1) 57:7 dropping (1) 60:8 dry (1) 22:3 due (1) 38:1 DUFFY (14) 6:5,5;18:14;37:7,10; 56:12;62:3,5;72:19,23; 75:12,16;78:19;85:15 duly (1) 5:10 during (5) 7:20;28:7;35:14; 80:8,14	E	18:7,17,20,25;19:19; 20:3,6;25:23,24;52:19, 20:53;10,10 equipment (3) 44:5;45:20;46:14 error (7) 15:6,6;53:22;54:12; 55:9,10,10 errors (3) 54:13;55:5,8 ESi (2) 33:19;34:4 essentially (5) 13:3;19:13;23:4; 42:13;81:19 established (1) 15:15 estimate (4) 13:3;15:5,5;55:24 estimates (1) 15:3 estimation (1) 31:21 etcetera (2) 59:17;69:11 Ethernet (1) 73:1 evaluate (1) 38:9 evaporate (1) 29:12 evaporating (1) 29:5 evaporation (2) 29:8,14 even (14) 19:24;20:6,7;22:2; 33:16;34:12;45:9; 53:22;55:14;74:3;77:9, 11;83:20,21 event (11) 28:6,8,14,15,24; 29:20,21,22,24;30:1; 31:13 events (3) 29:4,4;31:22 eventually (1) 58:8 everybody (2) 63:12;64:7 everyone (2) 64:5,6 everything's (1) 57:2 evidence (3) 44:18,19,21 ex (1) 44:19 exactly (8) 13:6,11;16:17;54:15; 56:5,7;58:14;77:15 EXAMINATION (3) 6:14;38:20,24	examine (4) 36:17;37:18;41:8,11 examined (3) 5:12;38:4;40:10 examining (2) 38:8,12 example (3) 9:18;46:24;55:17 exams (1) 82:21 exceptions (1) 31:11 excess (1) 35:3 exchanger (1) 49:18 excursion (1) 30:20 excursions (1) 30:10 excuse (4) 12:7;35:10;43:15; 53:7 exemplar (9) 37:19;38:8,12,25; 39:19;40:6,24;79:6; 80:9 Exhibit (9) 6:21,24;7:11;70:10, 14,19;75:3,5,9 exorbitant (1) 57:23 expand (4) 8:15;9:4,20,21 expands (1) 9:10 expansion (7) 10:21;13:5;53:16,18, 19,24;54:3 expectation (1) 69:2 expectations (7) 68:20;69:1,4,8,10,11, 17 expected (2) 56:3;68:24 expensive (2) 57:13;61:22 experience (13) 8:16;9:12,13;40:25; 58:3;59:5,15,20;60:1, 19;61:2,6,9 experiment (1) 44:12 experimental (1) 44:7 experiments (5) 37:6;46:9;71:11; 74:25;75:19 expert (5) 61:15;63:14;64:2,17; 85:3 expertise (1)	33:18 experts (3) 63:15,15,16 explain (2) 13:7;76:24 explains (1) 77:1 explanation (1) 46:23 extent (2) 35:12;68:7 exterior (10) 17:12;18:7,8,17,21; 19:20,21;41:14,20,22 extraordinarily (1) 68:11 extreme (1) 34:6 extremely (9) 58:2,4,23;59:4,16,19, 25;60:18;61:10 extremes (1) 15:10
			F	faces (2) 19:10,12 fact (8) 17:21;25:20;26:14; 44:8;54:11;55:2;74:5; 82:14 factory (1) 39:25 failed (1) 31:14 failure (13) 30:24;31:8,9,12,13; 34:13;58:7,10,11; 59:10;69:22;80:15; 81:6 fair (2) 13:2;38:7 fall (3) 13:8;69:10;78:11 falls (2) 15:9,14 far (6) 16:5;34:23;39:18,20; 55:23;59:21 faster (1) 29:13 fatigue (8) 33:7,9,12,17,22; 34:13,17;35:2 FEA (1) 35:10 fell (1) 68:19 Fermilab (2) 45:21;46:9 Fertility (1) 5:22

few (4) 6:19;17:5;29:16; 53:5	58:21 flipping (1) 38:18	42:24;43:6,8;52:25; 53:2,4;71:22;74:5; 76:22;79:15,16,25; 80:3,3,4;81:7;85:8,11	greatly (1) 21:4	honestly (1) 51:9
field (2) 48:13,16	flow (1) 50:13	gaseous (3) 26:11,21;27:4	guess (3) 24:23;25:2;57:21	Hope (1) 61:8
Figure (6) 75:11,14,15,17;76:8; 77:13	fluctuations (1) 29:18	gassing (1) 84:22	guys (2) 7:9;75:14	host (1) 5:15
fill (57) 16:14,22;17:11; 19:19,20;20:10;21:10, 18,23;22:9;25:19;26:5, 7,15,19,22;27:3,10; 28:4,6,7,14,20;29:3,4, 19,20,21,21,24,25; 30:11,25;31:1,4,14; 32:2,17,19,33;1;35:2, 15;36:10,13;38:20,24; 39:6,18;40:5;45:4,4; 49:2,3,17;53:13;56:6; 64:10	fluid (2) 45:24;49:21	gauge (1) 80:6	H	hour (3) 5:4;37:7;62:3
filled (22) 12:13;15:25;21:24; 22:6,17;23:1,10,14; 26:1,2,23;27:15,16; 32:13;35:20,22,24; 38:5;69:15,15;70:7,7	fluids (1) 64:13	gave (2) 35:6;55:16	half (2) 70:4;79:5	house (2) 24:4,5
filling (2) 22:6;33:2	flux (1) 27:11	general (2) 32:13;48:2	hand (2) 6:10;14:8	human (4) 61:3,7;68:16,19
fills (5) 32:22,22;35:25;36:7, 15	fly (1) 56:19	generally (2) 10:11;11:11	handbook (1) 8:22	hypothetical (1) 19:22
filter (1) 55:7	follow (1) 12:23	gets (5) 25:7;30:17,18;52:24; 73:7	handle (1) 83:2	I
final (2) 45:2,16	followed (1) 12:8	getter (20) 42:3,4,11,14;52:22, 23,24;53:1,2,5,7;69:25; 74:5;79:9,16,23;81:3, 7;84:21;85:9	happen (3) 79:2;83:25;84:2	idea (2) 13:13;32:13
find (2) 42:21;59:18	follows (1) 11:19	gettering (1) 79:10	happened (3) 48:15;70:4;79:6	ideal (2) 80:3;85:11
finish (1) 78:19	follow-up (1) 85:13	given (1) 75:25	happens (3) 22:5;32:21;34:11	Ideally (1) 26:9
first (11) 11:17;31:15;38:1,2; 39:12;49:16;80:14; 81:3;83:8,24;85:2	forces (2) 45:22;46:2	gives (3) 11:13;14:24;84:21	happy (1) 80:17	identical (3) 78:6,8;79:12
firsthand (7) 58:3;59:5,15,20; 60:1,19;61:2	form (4) 50:4;71:16;74:9,10	glance (2) 73:18;74:12	hard (2) 13:6;43:19	identification (3) 6:25;70:15;75:6
fitting (5) 14:11;35:2;43:20; 46:25;81:16	forms (1) 68:8	goes (16) 14:20;15:6;16:7; 28:10,21,23;29:23,25; 30:19;31:18;32:17; 34:14;49:6,8;55:11; 57:18	hardware (8) 56:18;57:23;58:8,15; 60:22;84:12,13,14	identified (3) 41:24;59:21,23
fitting's (1) 40:12	forth (1) 5:12	Good (10) 5:14;6:15,15,17; 25:9;37:9;55:24;56:8; 79:10;85:15	head (4) 23:1,4,6;82:20	identify (2) 6:2;41:19
five (1) 54:10	four (1) 54:6	governing (4) 67:5,11,19,24	headed (1) 83:2	image (1) 43:20
five-minute (1) 37:8	fourth (1) 56:15	grad (1) 46:21	heat (6) 13:24;14:4;21:3; 48:1;49:18;54:16	implemented (3) 65:25;66:23;67:18
flanges (2) 10:15,20	fraction (2) 12:3,5	grading (1) 54:20	heat-affected (1) 39:3	implication (1) 67:4
flash (1) 52:1	Francisco (1) 5:17	graduate (2) 47:2;57:12	helium (4) 45:15,24,24;49:15	implode (1) 79:15
flew (1) 58:8	FRANKLIN (4) 5:8,24;75:12;85:16	gram (2) 77:5,22	help (1) 82:24	implosion (2) 70:4;83:25
flight (1)	free (2) 9:19,21	grams (2) 77:5,21	hereinafter (1) 5:12	imply (1) 66:13
	fulfilled (1) 69:17	granular (1) 78:15	high (9) 31:9;42:11;45:22; 46:2;51:7;71:9;74:13; 76:4,7	important (5) 11:21;17:19;25:22; 64:1,21
	full (4) 28:12,12;80:15;81:5	graph (5) 34:14;71:14;74:8; 75:1,21	higher (6) 22:7;50:1,17;72:9; 77:19;78:4	inactions (1) 68:11
	fully (1) 69:13	Great (2) 7:18;13:25	holding (1) 79:16	inch (4) 17:22;20:12;21:18; 33:5
	function (7) 8:23;53:19;62:14,17; 64:21;65:7;70:1	greater (1) 80:6	holds (1) 26:4	inches (33) 21:11,16,17;22:6,8, 10,18;23:2,10,15;26:4; 27:16,17,22;29:23,23; 30:4,4,15,25;31:1,4,15; 32:6,6,7,9,14,15,16,23; 34:8;82:1
	further (2) 39:3;85:12		honest (1) 19:17	incident (1) 84:10
	future (1) 82:15			include (2) 24:20;56:21
	G			included (2)
	game (1) 28:15			
	gas (21) 24:20;26:12,18;			

30:1;71:9 includes (1) 29:22 increased (1) 52:15 Incredibly (4) 28:5,14,17;57:13 indeed (1) 44:13 indicate (3) 35:6;39:4;41:25 individual (4) 24:20;30:2,6,13 induced (2) 10:1,2 industry (2) 45:18;71:23 infinitely (1) 56:9 inform (1) 38:25 information (1) 33:18 in-house (1) 37:5 initial (1) 34:6 initiated (2) 36:10,13 inner (22) 19:5,8,9,9,11;22:17; 23:1,3,6,10;25:4;35:2; 42:24;45:3;49:7,9,10, 11,13,14,19,22 innermost (1) 23:19 insert (1) 58:12 inserted (1) 27:13 inside (21) 15:21;17:19,24; 19:23;20:6;23:14;24:4, 7;25:17;38:22;42:13; 43:8;44:10;45:6;49:4; 53:1,2,6,7;70:3;80:4 inspect (2) 37:22;38:23 inspected (2) 37:24;38:5 inspection (1) 38:11 Inspectors (1) 67:18 instance (2) 10:15;83:4 instructed (1) 47:7 instructions (3) 47:11;81:14,20 instrument (1) 57:17 insulation (21)	20:1,8;23:13,16,18; 24:1,2,6,8,9,10,12,17, 23,24;25:15;42:1,10, 12;70:1;79:21 intact (3) 39:6;42:13,19 integrity (5) 41:25;43:1;56:20; 69:3;70:2 intend (3) 35:1,4,13 intent (1) 82:7 intentionally (2) 80:10,12 interesting (4) 21:13,17;83:7,15 interior (1) 18:22 interval (1) 66:7 into (19) 7:4;12:1;19:16; 28:23;33:14;44:8;49:4, 6,12,22;50:23;54:5; 73:15,17,19;74:9; 78:24;79:5;84:20 Invar (1) 10:24 investigation (1) 84:11 involved (5) 10:4,5;29:2;63:25; 66:19 involves (1) 52:21 irrelevant (3) 20:14;25:16;31:7 irreplaceable (1) 57:24 isolated (1) 13:19 isotherms (2) 70:25;76:15 item (1) 57:25 items (1) 37:5 IVF (2) 27:2,7	joining (1) 6:16 joint (9) 9:10,11,13,14,15,19; 10:4,6,12 joints (1) 10:9 junior-level (1) 54:16 jury (2) 35:1,13	K	Kasbekar (4) 46:5;74:1;83:15,21 Kasbekar's (2) 53:11;56:9 keep (2) 56:20;65:19 keeping (1) 64:14 kelvin (11) 14:18;22:15;23:12; 31:18;32:17;54:11; 71:13;75:22;77:10,23; 78:4 kept (1) 16:16 Kevin (2) 6:6;85:13 kind (8) 10:9;11:12;37:4; 45:4;46:3;58:11,15; 78:24 kinds (1) 63:15 knew (4) 35:8;46:13,15;79:8 Knowles (1) 5:15 known (2) 65:15,16	L	lab (6) 16:15,25;27:2,7; 44:8;57:4 laboratory (1) 44:5 lack (1) 69:18 lacked (1) 41:25 large (3) 43:19;45:20;46:13 larger (5) 12:3,5;13:10;18:3; 53:22 largest (3) 30:21,22,23 last (12)	6:20;7:3;29:16;33:9; 34:19;44:8;61:4;63:6; 71:20;79:22;80:14; 81:23 later (2) 29:25;70:4 latest (1) 47:23 law (2) 80:3;85:11 layer (4) 25:4,6,7,15 layers (6) 23:17,17,19;24:17, 20;25:9 lays (1) 23:7 leak (30) 36:19,22,24;41:6,7, 13,16,24,25;42:3,8,9,9, 11,15,17,18,20,21; 43:10,10,11,12,14,17; 69:21,23,25;83:12; 84:20 leaking (1) 21:3 leaks (8) 41:14,17,19;42:5,6, 22;43:2;47:16 learning (1) 46:21 least (3) 13:4;33:25;68:22 leave (3) 57:8;68:5;82:3 leaving (1) 60:8 led (1) 69:19 left (6) 31:10;81:14,19,22; 82:10,17 length (16) 12:6,10;14:24;15:12; 20:21;28:21,24;29:3,4; 30:14,21,22,23;31:4; 33:15;54:22 less (6) 27:22;34:1;36:5,6; 77:9,11 level (38) 12:5;14:11;16:5,6; 21:22;22:7;24:15;26:5, 7;27:14,17,21,24;28:2, 7,10;29:1,9,23,25; 32:23;33:3,4;42:22; 56:24,25;57:16;60:24; 66:2,6,25;67:15,15,22; 68:3,7;70:2,3 level's (1) 34:8 lid (1) 29:11	lid's (1) 29:15 life (3) 29:18;33:2;34:5 lifetime (6) 25:18;33:7,9,12; 34:13;35:2 lifting (1) 38:18 light (1) 81:1 limit (2) 15:11,11 limited (1) 38:1 limiting (1) 15:12 limits (3) 15:13,13,14 line (33) 12:5,13;16:22;17:11; 19:19,20;20:11;25:19; 26:2,5,7,17,19,22;27:3, 10;28:4;29:19;30:25; 31:5,14;32:2,5;35:15; 45:4,4;49:2,4,17; 53:13;56:6,15;57:25 linear (1) 25:7 lines (2) 18:14;79:22 liquid (87) 12:5,13;14:11,12,22; 15:21,25;16:1,4,5,6,6; 20:25;21:12,22,24; 22:11,12,18,22;23:2,6, 11,15,19,20,23;24:15; 25:5,5;26:3,4,20,23,23; 27:3,8,10,14,24;28:2,7, 8,9,10,19,20,25;29:5, 12,22,25;30:18,20; 31:5;32:3,17,23;34:8; 37:2,3;38:5;45:15,15, 24,24;49:12,15,15; 50:7,15,22;51:6;53:6; 56:22;57:7;64:9,24; 65:23;66:9,21;69:16; 70:2;81:22;82:3,23,25 liter (1) 80:2 literature (2) 47:17,20 liters (4) 79:5,15,24,25 litigation (3) 5:23;44:24;46:6 little (11) 28:25;52:25;53:1,2, 4,6;55:5;62:3;65:1; 72:16,23 LN2 (1) 69:16 load (7)
	J	James (3) 59:12,23;60:22 Janis (3) 48:19,22,23 Japanese (1) 58:10 Joe (1) 83:13 John (2) 6:5;85:14						

IN RE PACIFIC FERTILITY
CENTER LITIGATIONFRANKLIN K. MILLER, Ph.D.
December 14, 2020

31:16,17;33:5;34:10, 10,11,12 loaded (1) 70:16 located (1) 5:16 log (1) 75:24 logs (2) 21:16;35:23 long (9) 20:20;30:25;31:1; 48:13,15;64:15;69:15; 70:6;82:22 longer (2) 8:19;27:18 look (20) 7:13;11:24;20:13; 21:16;30:23;35:23; 38:2,10,16,19;40:11; 41:9,13;43:25;54:17; 63:6;67:13;70:19; 73:13;77:16 looked (7) 37:25;38:3,4,13; 40:10;44:9;63:9 looking (10) 21:25;22:1,4;30:24; 31:8,12,13;37:21;44:3; 74:20 looks (3) 43:10,10,11 loose (1) 80:4 looser (1) 10:18 losing (1) 67:10 lost (1) 58:11 lot (8) 25:8;44:6,7;47:3; 57:18;72:10;73:21; 77:19 low (24) 9:1;20:25;43:9;51:7; 58:6;67:15,15;71:11, 11;73:11,13,20,23; 74:10,12,18,22,23,25; 75:18;76:3,6;77:20; 81:25 lower (22) 11:6,10,11;12:11,15, 25;13:1,2,7,14;15:2,11, 13,17;17:2,17;18:19, 24;19:15,18;50:25; 73:5	46:25 magnetic (2) 45:22;46:2 magnets (4) 45:23;57:11;58:25; 59:22 maintain (8) 32:24;42:1;60:7; 62:19;69:3;70:1,6,8 maintaining (1) 69:13 major (1) 29:3 majority (1) 12:14 makes (3) 7:8;20:10;51:24 making (1) 28:3 malfunction (1) 62:25 malfunctioning (1) 62:24 managed (1) 69:25 manner (3) 9:24;16:4;82:8 manual (1) 49:17 manufactured (2) 48:19;80:24 manufacturer (1) 72:3 manufacturers (1) 78:9 many (5) 36:10,13;73:15,15, 16 March (2) 33:7;69:22 marked (3) 6:24;70:14;75:5 marketed (2) 71:22,23 marks (1) 85:17 mass (8) 41:7,10,13,16,24; 42:8,18,20 matches (1) 17:19 material (41) 9:2,17;10:18;11:4,5; 14:19;19:13;52:9; 53:14,16,17;56:10,21; 57:5,9;58:2;59:4,16, 19;60:19;61:20,22; 64:14;65:3,19;68:6,16; 69:2,6;71:9,25;72:1,5, 11;73:4,16,17;76:16; 77:4,5;79:8 materials (18) 8:15,17;57:6;58:5,	19,20,23;59:1,22;60:1; 61:10;63:16;65:10; 68:23;69:5;71:25;73:2; 78:24 matter (1) 5:22 maximum (2) 14:8;30:10 may (12) 6:8;10:15;26:16; 29:8;36:8;47:22;57:24; 64:11;65:15,16;78:22; 82:6 maybe (7) 18:18;26:17;31:11; 58:16;74:3;79:3;83:21 mean (20) 8:12;12:9;13:3; 31:19;33:9,12;35:10; 60:4,14;63:10;64:23; 66:12;71:8;72:7;74:13; 77:15;81:19;84:19; 85:6,7 meaning (1) 34:6 means (6) 11:11;13:8;14:16; 34:23;79:25;80:3 meant (1) 66:11 measure (2) 16:11;66:20 measurement (3) 66:13,19;74:4 measurements (3) 17:3;73:10,11 measuring (3) 65:23;66:2,6 meet (1) 69:8 mentioned (1) 83:8 metal (13) 7:24;8:6,8,11,13,19, 24;9:4,10,22;10:4,5; 20:10 metals (1) 53:20 micropore (1) 78:18 middle (1) 59:10 might (3) 51:15;57:24;79:11 MILLER (11) 5:8,24;6:15;7:12,24; 9:4;11:6;37:18;62:12; 70:18;75:8 million (1) 58:14 millions (2) 58:13;61:1 mind (1)	80:21 minimal (2) 16:19;53:5 minor (1) 31:11 minus (1) 75:25 minute (1) 61:25 minutes (2) 29:17;62:4 mission (4) 58:9,9,22;60:22 mission's (1) 57:25 MIT (3) 83:9;84:9,17 mitigated (1) 42:23 MLI (1) 25:15 model (4) 18:24;19:14;24:17; 31:22 modest (1) 77:18 molecular (1) 78:6 molecules (8) 42:15;53:8,8;73:15, 16;76:18,25;79:11 Monday (2) 5:3,18 monitoring (3) 65:20;68:8;69:7 Monte (1) 24:18 more (8) 55:2;57:14;60:7,9, 12;61:22;74:12;77:23 morning (3) 5:14;6:15,17 most (4) 33:2;36:3;60:3,21 move (1) 24:7 much (18) 6:18;8:8,21;12:15; 14:24;16:23;27:15; 55:13;57:1,14;58:14; 67:7,20;74:5;78:3; 79:1;81:6,22 multilayer (3) 20:8;23:18;25:15 multimillion-dollar (1) 57:17 multiple (4) 22:1;55:1;58:13,13 multiplying (1) 36:2 must (1) 68:3 MVE (23)	21:11;22:10;25:18; 26:4,14;27:7;29:6; 37:25;38:8,12,14,25; 40:2,24;41:3,3;43:21; 44:4;46:25;48:9;61:13; 76:17;79:16 MVE-type (1) 44:15
N				
N2 (1) 73:16 name (5) 5:15;71:18,19,23,24 NASA (4) 24:19;59:3;63:13; 84:10 National (1) 67:18 near (4) 15:23;16:8;26:23; 52:25 nearly (1) 47:1 necessarily (4) 40:17;62:23;64:17; 66:18 neck (9) 11:23,25;12:7;14:12; 20:24;23:23,24;24:25; 80:7 need (9) 8:5;55:12;60:6; 61:25,25;68:7;80:22; 81:9;82:24 needed (5) 65:19,20;82:15,19, 21 negligibly (1) 28:1 neither (1) 51:21 net (1) 21:3 new (2) 32:20;36:23 nitrogen (88) 12:12,14;14:12,17, 20,21,22;15:21,25; 16:1,4,7;21:12,20,24; 22:11,13,18,22;23:2,6, 11,15,20,20,23;25:5,5; 26:3,5,11,11,12,18,20, 21,23,24;27:4,4,8,10; 28:19,20;29:5,12,22; 30:20;31:6,24;32:3,15, 18,34;9;37:2;38:6; 45:15;49:16;50:7,15, 22;52:9,13,17;53:2,7,8; 56:22;57:7;64:9,24; 65:23;66:9,21;70:2,24; 71:17;72:13;77:24;				

M**machine (1)**
47:4
machined (1)

78:4;79:5,10,15;80:3; 81:22;82:3,24,25 nodes (1) 56:2 nondimensional (2) 71:14;74:9 nor (2) 17:4;83:21 normal (4) 16:3;27:2;30:7,11 notice (1) 80:24 November (1) 37:20 number (18) 5:23;17:7,8,22,22; 18:2;22:4;23:17;25:3; 29:24;33:12,23,25; 34:23;35:17;36:2,14; 56:2 numbers (3) 18:1,4;77:17 numerical (1) 14:5	9:25;10:18,19;22:2; 24:16;28:12,12;30:14, 21;36:3;37:3;40:22; 41:3;43:20;45:1,15; 46:21;48:25;50:1,9,16; 52:23;53:11,23;55:8; 57:10;61:24;64:9; 72:12;73:4,6,7,12; 74:1;75:12;77:3,6; 79:1;80:23,24 one-of-a-kind-in-the-world (1) 58:21 ones (3) 37:6;60:3,21 One's (2) 78:9;79:1 only (15) 11:20;27:20;28:7; 38:22;40:9,22;41:1,3; 45:5;60:16;70:2;76:8; 78:2;80:13,23 onto (1) 63:8 oOo- (3) 5:2,13;85:23 open (3) 75:8;81:20;82:16 opening (2) 49:22;50:9 operated (2) 21:15;61:17 operating (4) 15:20;16:3,4;30:11 operation (2) 15:18;30:7 opinion (7) 35:19;52:8;66:25; 73:25;76:16;79:13,14 opinions (2) 34:20,22 optics (2) 63:15;65:10 order (1) 79:4 ordinary (9) 61:12,16;63:10,18, 24;64:3,4;65:4,12 O-ring (1) 42:6 out (32) 15:16;20:15;21:5; 25:6;27:13;29:5;39:3; 43:8;45:2,5,16;53:5; 55:23;57:8;59:18; 65:13,17;66:24;72:16; 73:5,7,22;74:2;75:23; 76:2;82:2,3,3,4,6,20,25 outcome (1) 34:24 outer (8) 17:13;19:9;24:25; 25:7,15;40:13;42:24; 45:3	outside (9) 19:24;20:2,3,9;24:5, 6;41:18;44:23;45:6 over (22) 17:6,6;25:11,18; 30:14;38:18;41:5;42:6; 44:8;52:22,22;62:3; 64:24;69:23;75:24; 77:4,17,21;79:14;82:5, 6,22 overnight (1) 57:8 overseeing (7) 58:3;59:5,15,20; 60:2,20;61:2 own (4) 14:2,14;36:1;82:6 oxygen (2) 72:13;79:11	P	Pacific (8) 5:20,22;37:12,16; 62:7,11;85:19,19 page (24) 11:7,8,8,10;13:3,16; 17:10;18:10,12;25:21; 33:6;34:19;56:11,13, 14;59:14;63:6,8;68:10; 69:9;70:22;71:1,2; 77:14 paper (22) 70:23,23,24;71:5,9, 10,12;72:2,6;73:18,19; 74:7,11,13,24;75:3,10, 18;76:9,11,24;77:1 papers (2) 74:20,22 paragraph (8) 25:22;33:10;34:19, 20;70:22;71:1,3,6 paramagnetic (1) 58:25 Parrington (3) 33:20;34:4;35:5 Parrington's (4) 33:13;34:16,21,24 part (17) 9:25;10:2,12,24; 11:23;12:7,10,11;28:9, 10;37:21;47:5;54:20; 55:13;63:21;74:17; 75:21 particular (16) 14:25;21:14;24:15; 46:9;47:24;50:4;54:14; 60:15,17;64:7,13,22; 72:1;73:17;77:1;85:6 parties (1) 6:1 parts (2) 9:19;10:14	pass (6) 13:10;40:11;49:25; 50:9,15,22 passed (3) 18:3;35:4,9 past (2) 34:1,13 pause (1) 61:24 peak (1) 33:24 pellets (1) 78:25 penetrate (1) 49:5 penetrates (1) 49:4 penetration (1) 49:7 people (10) 35:10;47:14;58:16; 63:11,14,19,20;64:8; 65:9;68:23 per (11) 8:25;9:1,1;12:6; 35:22,23,24;36:3;66:6; 77:5,22 percent (11) 20:13;46:17;48:23; 74:2;76:17,20,21,25; 77:10,11;79:3 perform (2) 70:1;74:15 performance (4) 69:20;79:3,7;81:7 perimeter (1) 39:4 person (4) 33:13,17;64:16;85:2 personally (1) 5:7 perspective (2) 15:24;37:24 Peterson (1) 5:5 PFC (2) 16:15;83:21 PFC's (1) 68:11 PhD (2) 5:8;47:9 Philip (4) 5:15;7:1;70:11;75:2 photos (1) 84:15 phrased (1) 50:8 physical (1) 38:3 Physically (1) 49:21 pick (1) 64:23	picked (1) 51:10 pictures (1) 84:10 piece (6) 9:22;14:19;56:17; 57:5;84:12,14 pieces (1) 47:4 place (14) 5:21;16:7;20:2;37:3; 42:4;57:1,19;64:9; 69:7,7,14;77:6,18;84:5 placed (1) 6:12 places (1) 55:23 plaintiffs (3) 5:9,25;6:4 Plaintiffs' (4) 6:24;70:10,14;75:5 plane (2) 82:19,20 please (3) 6:1,10;70:11 plug (6) 62:1;81:20;82:4,16, 23,25 plumbing (1) 26:15 pm (3) 85:19,19,22 point (8) 7:19;24:12,13;31:4; 32:1;49:19;53:3;77:6 points (1) 76:3 pore (1) 43:7 port (13) 21:10,18,18,23;22:9; 35:2;38:21,25;39:6,18; 40:5;81:17,17 portion (7) 26:19,21,22;27:9,18; 32:2,5 portions (1) 27:3 possession (1) 85:2 possibility (2) 43:14,17 possible (4) 11:15;15:6,11;80:25 possibly (2) 69:23;76:21 potential (1) 47:16 potentially (1) 56:19 pour (1) 64:25 precaution (1)
---	---	---	----------	---	---	---

56:25 precautions (1) 57:19 preferentially (1) 73:4 preps (2) 46:23;47:3 presale (1) 48:7 present (4) 27:4,4,8,10 preserve (1) 56:16 preserved (1) 82:15 pressure (51) 50:2,10,13,17,21,25; 51:2,7,8,13,17,22,25, 25;52:4,6,7,15,21,21, 22;71:9,11;72:11;73:2, 3,5;74:10,12,14,23,25; 75:19,23;76:2,3,4,6,7, 7,19;77:20,20,25;79:6; 80:2,5,7,17;81:9;85:10 pressures (2) 72:9;77:18 pressure's (1) 80:1 pressurized (1) 52:13 pretty (3) 13:21;16:23;57:10 prevent (4) 62:23;63:3,4;81:11 previously (1) 52:10 principles (1) 9:11 prior (2) 48:18;69:21 probably (5) 47:18;54:9;55:9; 76:20;80:25 problem (4) 25:14;54:15,15,17 problems (1) 62:21 procedure (2) 66:22,23 procedures (5) 62:13,17;65:6;69:7, 18 proceedings (1) 85:21 process (3) 51:7;83:19;84:5 produce (1) 13:4 Professor (3) 83:13;84:19,25 profile (31) 11:19,20,24;12:8; 14:2,7,13,15;15:9;	17:18;20:18,19,21:1,5; 23:18;24:17;27:1;28:4, 16,18,22;30:5,7,8,13, 18;31:2;32:11,12,20; 54:21 profiling (2) 11:16;34:7 proper (1) 42:1 properly (2) 63:2;66:1 properties (3) 14:6;21:8;55:25 property (2) 9:3;11:5 protected (1) 19:25 provide (1) 33:21 provides (1) 18:24 prudent (1) 67:6 psi (6) 71:13,16;72:5,6; 73:19;80:5 pump (4) 42:13,15;73:5,7 pumping (1) 64:25 purchase (1) 36:16 purpose (2) 42:18,20 purposes (2) 25:4;73:24 push (1) 66:17 pushing (1) 66:14 put (12) 6:20;15:5;20:23; 44:17;45:5,11,12; 65:17;74:9;79:4,5,24	R radiation (1) 13:24 Raise (2) 6:10;73:3 raises (1) 80:5 ran (1) 80:15 range (4) 17:8,8;68:9;74:14 rare (3) 10:8,10;26:16 rate (5) 10:19;13:23;29:8,14; 81:25 reabsorbed (1) 52:16 reabsorbs (2) 53:3,9 reaches (2) 33:3;53:10 read (1) 74:7 reading (1) 59:14 ready (1) 16:14 real (3) 62:1;84:6,8 realistic (2) 31:21,22 realize (1) 26:1 really (12) 33:14;45:20;50:18, 20;51:9;52:18;53:3,9; 57:20;58:1;67:6,20 reason (4) 31:25;54:9;55:16; 71:20 reasonable (3) 13:21;16:12,12 reasoning (1) 19:16 reasons (1) 73:12 rebuild (1) 58:13 rebuttal (8) 6:23;7:17;11:7; 25:21;47:23;70:9;78:2; 83:15 recall (1) 48:18 receive (1) 36:16 recent (1) 81:1 reckless (1) 68:12	recognize (3) 7:14,15;70:20 recollection (1) 44:13 record (8) 6:9;37:12,16;61:25; 62:2,6,11;85:18 reduce (2) 52:4,6 reduced (4) 51:22,25,25;52:7 refer (10) 7:20,22;17:11,15; 18:7;25:23;68:10;69:4, 9;70:23 references (2) 7:22;33:22 referring (11) 17:12,15;18:8;19:3, 8,10;48:19;68:13;71:6; 75:10;77:12 refill (2) 32:25;33:1 registered (1) 71:23 regular (4) 62:19,19;66:7;69:16 regularly (5) 21:15;27:9;63:3; 65:20;68:18 related (2) 52:23;59:22 relates (1) 50:3 relative (1) 57:20 relatively (2) 10:7,12 release (2) 51:18;76:25 released (1) 52:9 releases (1) 76:17 relevant (10) 19:23;20:17;21:14, 21,21;31:15;34:22; 39:14;60:13,16 relied (2) 47:20,22 relieve (4) 51:2,15,17;52:1 relieved (1) 80:17 remain (3) 32:7;42:12;53:1 remember (2) 71:19;83:13 REMEMBERED (1) 5:3 remote (4) 67:1,22;68:3;85:18 remotely (2)	5:5,21 remove (3) 81:15,16;82:2 removed (2) 29:11;82:23 removing (1) 82:25 repaired (1) 42:23 repeat (1) 62:15 replace (1) 28:11 replaceable (3) 57:4,21,22 replenished (1) 27:9 replicate (1) 56:5 report (33) 6:23;7:17,22;11:7; 13:3,17;17:10,21;18:6, 23;19:4;25:21;33:6,8; 37:20;47:23,23;56:11, 15;59:14;60:12;63:7; 68:10;69:9,12;70:10, 21,23;71:3;78:3;81:24, 25;83:16 Reporter (9) 5:6;6:8,10,13;61:24; 62:4;72:15,21,25 Reporters (1) 5:16 reporting (1) 34:17 reports (2) 6:20;47:21 representations (1) 40:7 represents (1) 20:4 require (4) 67:8,21,24,25 required (7) 38:17;67:1,3,5,12, 17;74:15 requirements (2) 67:14,16 requires (1) 67:25 requiring (3) 65:5;67:3,4 research (2) 36:21,25 residual (1) 24:20 respect (1) 27:25 rest (1) 79:4 restate (1) 27:6 result (2)
	Q quantify (1) 8:21 quantitative (1) 74:15 quantity (2) 8:10;11:12 quarter (1) 82:1 quick (3) 49:5;62:1;81:1 quickly (1) 28:9 quite (4) 22:7;48:15;52:18; 82:11			

9:17;34:18 results (6) 34:3,24;35:4,6,11,11 retain (1) 53:7 revac (1) 65:15 reviewed (1) 48:7 rid (1) 78:17 right (12) 6:10;7:19;12:22; 28:10;51:16;53:21; 54:8;67:8;72:25,25; 78:1,2 right-hand (2) 75:21;77:16 ring (1) 40:13 RINGEL (2) 6:6,6 rise (1) 70:3 rises (1) 52:20 risk (2) 67:10,20 rod (1) 21:4 Ron (4) 13:10;18:3;34:16; 35:5 Ron's (1) 20:17 room (27) 8:24;9:23;12:4; 15:22,23;16:8,15,18; 17:5,7;20:25;25:1,8; 26:25;30:15,16;31:5; 18,23;32:16;52:25; 54:18;76:18,25;77:2; 79:17;85:9 rooms (1) 85:9 root (1) 22:10 route (1) 21:11 RPR (1) 5:6 run (4) 46:16;49:15;80:22; 82:6 running (1) 16:25 runs (2) 20:24;63:8	safety (9) 67:14;68:20;69:1,4, 6,10,11,17;70:6 same (12) 7:5;8:24;9:15;11:3; 19:13;21:1;26:5;45:8; 60:9,24;61:1;71:24 samples (5) 21:22;27:8,13,13; 69:14 San (1) 5:17 save (1) 7:9 saved (1) 7:3 saw (10) 33:24;38:1;39:25; 79:6;81:23;83:9,22; 84:9,14,16 saying (11) 27:12,24;34:3;47:7; 55:4;59:8,13;60:16; 83:16,18 school (2) 46:21;47:2 science (1) 55:22 screen (3) 7:4,6,8 screws (2) 10:16,20 seal (2) 45:13;46:24 sealed (1) 79:25 seals (1) 42:6 search (1) 46:17 searched (1) 46:11 searching (1) 46:12 second (9) 7:9;43:13,16;47:23; 70:22;71:1,3;75:13; 80:20 secondary (2) 44:18;67:16 section (7) 20:21,22;33:10; 34:19;56:11,14,15 sections (1) 11:22 seeps (1) 43:8 SEM (1) 64:11 sense (6) 7:8;49:12;51:22,24; 60:4;69:17 sensitivity (1)	56:2 sent (3) 7:4;54:24;55:3 sentence (6) 19:4;60:11;63:6,7,9; 69:12 separate (2) 72:12;73:6 separation (1) 72:14 service (2) 35:14;37:1 served (1) 62:22 set (7) 5:3,12;11:14;14:25; 15:11;33:3;73:17 sets (1) 14:14 seven (1) 18:14 several (2) 42:2;69:24 share (2) 7:6,8 shared (1) 7:5 shell (1) 17:13 shock (2) 28:18;57:5 shocked (1) 30:18 short (4) 12:10;68:19;69:10; 80:24 shorter (1) 8:17 Shorthand (1) 5:6 short-term (1) 61:20 show (1) 36:4 shows (1) 85:4 shrinks (1) 28:22 side (10) 19:8,9;22:16,25; 23:9;44:25;46:15; 50:24;51:2,12 sided (9) 39:1,1;40:19,19; 43:23;44:2,20,21,22 sieve (11) 52:9,12,16,16;76:21, 24;78:6;83:5;84:18,24; 85:5 significant (2) 28:6;78:25 significantly (2) 11:4;27:21	Siliporite (4) 71:18,21,24;77:24 similar (4) 10:21;47:1,5;78:9 simple (1) 85:7 single (11) 23:17,24;24:8;25:3; 31:13;36:20;39:1; 40:18;42:16;44:20,21 single-side (1) 48:17 single-sided (14) 39:8,9,15,16,19,22; 40:6,15;44:12;45:5,17, 19;47:3;48:8 sites (2) 53:6;73:14 sits (1) 21:18 sitting (6) 14:9,10;28:17;32:14; 60:5;61:14 situation (6) 20:4,18;21:15;50:19; 67:11;77:15 six (3) 16:16;31:10;35:14 size (4) 42:3,9,17;43:20 sizes (1) 78:18 skip (7) 43:13,16,18,18,20; 45:25;46:8 slack (1) 11:1 slight (1) 16:18 slightly (2) 50:1,16 slow (5) 11:22;42:6;69:23; 72:18;83:12 slowly (2) 28:9;43:8 small (14) 17:8;22:3;27:14,23; 28:1,2,3,5,13,17;42:5, 11;78:12;79:3 Smith (1) 83:13 solid (1) 50:4 solution (1) 54:25 somebody (1) 46:18 somebody's (1) 67:4 someone (5) 8:8,22;26:16;65:1; 68:1	sometimes (2) 11:13;57:4 somewhat (1) 57:19 somewhere (1) 15:9 sorry (8) 7:9,10;25:11;33:8; 56:12;62:15;78:20; 85:19 sound (1) 51:15 sounds (2) 29:17;37:9 space (30) 19:11,12;23:14; 41:14,15,17,20,22,22; 43:6,8,23;44:2,7,11; 49:4,7;50:1,2,10,16,23; 52:13,15;56:19;58:21; 59:12;79:21;80:4; 84:20 spacecraft (3) 57:18;58:10,10 spaceflight (1) 57:23 spaces (2) 50:1,16 span (1) 29:18 speak (1) 26:1 speaking (1) 10:11 spec (2) 41:7,10 species (5) 72:12;73:4,6,8,9 specific (4) 7:22;50:6;54:5; 81:14 specifically (13) 8:19;36:14;38:7,11; 39:2;41:2,11;47:7,14; 48:5;54:4;72:8;83:8 specification (1) 65:18 spectrometer (6) 41:13,16,24;42:8,18, 20 spoke (1) 6:20 spring (1) 10:25 stack (1) 10:14 stainless (5) 10:9,16,22;14:6; 20:23 Standard (13) 5:20;37:12,17;45:19, 19;62:7,11;79:15,24; 80:2,2;85:19,20
S				
safely (1) 82:23				

stands (1) 50:7	57:13	talking (10) 13:7;17:21;22:1; 28:25;31:16;41:2;46:3; 60:25;61:21;83:13	30:15	47:18;22
start (2) 8:18;79:14	study (2) 56:2;72:8		temperature (150) 8:11,16,18,23,25,25; 9:1,1,14,15,23,23,24, 25;11:3,16,19,20,24; 12:3,4,4,9,12,15;14:2, 3,4,6,7,12,13,15,20,21; 15:9,23;16:2,7,9,15,18, 21,21,23,24;17:1,3,5,7, 18;19:21;20:25;21:1,1, 5,10,19,20;22:9,13,16, 21,23,25;23:9,13,16, 18,21,24;24:1,5,7,7,8, 16,19,22;25:1,6,8,14, 16;26:20,24,25,25; 28:16,18,22;30:3,5,7,8, 13,14,16,20;31:2,5,6, 18,23;32:3,8,11,12,15, 16,18,20;34:9;49:15; 50:21;52:20,21,23,25; 53:14,17,20,21;54:19, 20,21;55:25;58:7;60:6; 64:14;69:14;71:11; 73:12,14,20,23;74:14, 21,22,25;75:18;76:1, 18,25;77:2,8;78:3,4; 79:17;85:10	Thanks (2) 52:8;75:16
started (1) 32:5	stuff (1) 46:21	tank (175) 11:21;12:5,6,7; 15:18,19,19,20,21,24; 16:3,6,13,16,22;17:3, 12,16;18:7,8,17,17,19, 20,21,22,25;19:3,20, 21,23;20:5;21:11,14, 15,19,21,21;22:3,7,10, 17,17;23:1,5,10,14,22; 24:15,24;25:25;26:4; 27:2,15;29:11,18;31:9, 19,22;32:24;34:7,11, 12;35:14;36:6,10,13, 16,20,23;37:19,23,24; 38:3,8,12,17,18,22,25; 39:6,17,19,23;40:3,6, 16,22,23;41:1,3,10,20; 42:14;43:1,21,24,24; 44:3,3,15,17;45:11,13, 14;48:19,21,23,24; 49:9,9;50:7;52:8;56:6; 60:8;61:17;62:14,18, 20,23;63:1;64:24; 65:17,18,23;66:6,9,15, 17,21;67:7,10;68:7,19; 69:5,7,9,13,19,19,21, 24,25;70:2,3,5,7;74:4; 76:19,23;79:6;80:7,7,9, 11,12,13,15,18,20,22, 23;81:3,10,11,15,22; 82:1,3,9,14;83:5,11,12; 85:5	25:11:3,16,19,20,24; 12:3,4,4,9,12,15;14:2, 3,4,6,7,12,13,15,20,21; 15:9,23;16:2,7,9,15,18, 21,21,23,24;17:1,3,5,7, 18;19:21;20:25;21:1,1, 5,10,19,20;22:9,13,16, 21,23,25;23:9,13,16, 18,21,24;24:1,5,7,7,8, 16,19,22;25:1,6,8,14, 16;26:20,24,25,25; 28:16,18,22;30:3,5,7,8, 13,14,16,20;31:2,5,6, 18,23;32:3,8,11,12,15, 16,18,20;34:9;49:15; 50:21;52:20,21,23,25; 53:14,17,20,21;54:19, 20,21;55:25;58:7;60:6; 64:14;69:14;71:11; 73:12,14,20,23;74:14, 21,22,25;75:18;76:1, 18,25;77:2,8;78:3,4; 79:17;85:10	thereupon (1) 5:11
starters (1) 6:21	subjected (4) 16:22;25:19;27:22; 35:15			thermal (26) 10:21;11:18;13:20; 15:1;17:24;19:25;20:3, 6,18,19;25:4;27:23; 28:3,12,24;33:15; 34:10;35:5,8,9,15; 53:12,19,24;54:2;79:7
starting (5) 31:3;32:1,2,8;72:23	successful (1) 48:16			
starts (1) 54:18	successive (1) 25:6			
state (1) 26:12	sufficient (2) 66:1,8			thermally (2) 10:2;13:19
statement (3) 6:9;84:7,23	Suite (1) 5:17			thick (1) 20:10
states (1) 18:24	summing (1) 14:23			thicker (1) 12:2
stating (1) 19:14	super (1) 45:24			thickness (1) 47:5
station (1) 64:11	superconducting (3) 45:23;58:25;59:21			thicknesses (1) 47:1
stay (2) 53:2;76:20	supply (2) 26:13;83:10			thin (2) 19:13;21:2
steel (5) 10:9,16,22;14:6; 20:23	support (2) 46:14;54:18			thinking (4) 18:18;45:1,14;64:16
steps (1) 56:3	sure (17) 18:5;20:13;44:12; 47:24,25;48:23;50:3; 51:5,14;62:4,16;67:8; 74:19;75:13;78:1; 80:16;82:14		temperature-dependent (2) 9:2;21:8	thinner (1) 11:24
still (1) 14:21	surrounding (1) 41:23		temperatures (8) 25:19;65:11;70:8; 72:4,7,9;74:18;78:5	third (3) 34:2;77:6,17
stops (1) 32:19	swap (1) 74:2		tens (1) 60:25	thoroughly (1) 38:4
storage (18) 58:3,6;59:6,8,16,21; 60:2,4,4,7,10,12,13,16, 20;61:3,7;64:19	swing (2) 72:11;73:3	tanks (31) 39:25;40:21;41:5; 44:9,23;46:3;48:16; 61:13;63:23;64:5,8,9, 20;65:5,12,21;67:2,21; 68:4,8,19;76:17;83:9, 14,16,19,23,24;84:16, 24;85:3	tenth (2) 22:12,22	though (7) 10:10;18:6;25:7; 46:10;50:19;59:13; 66:1
store (2) 27:8;68:19	sworn (1) 5:10		term (2) 33:6;63:10	thought (6) 41:2;48:22;55:3; 73:21;74:5;83:17
stored (3) 56:22;68:24;69:5	synthetic (3) 72:1,2;73:22		terms (1) 57:12	thousands (1) 60:25
stores (1) 68:21	system (7) 20:1,24:1;26:15; 42:22;64:25;65:16; 74:15		test (25) 8:14,21;36:19,22,24; 41:13,17,24;42:18,21; 43:10;57:5,7;59:10; 78:16,21;80:14,14,15, 20,23;81:2,3,12;82:22	three-dimensional (1) 25:14
storing (1) 68:14	systematic (11) 62:12,16;65:5,24,25; 66:7,10,12,16,22,23 66:16	tank's (2) 22:5;32:14	tested (3) 40:24;48:3;59:9	throughout (1) 30:3
strain (2) 33:23,24	systematically (1) 66:16	task (1) 64:22	testified (1) 5:12	tighter (1) 10:17
strains (1) 34:6	systems (9) 63:5,11,13,16,18,20, 21;68:24,25	tasked (1) 65:1	testify (3) 35:1,4,13	tightness (1) 41:7
strategy (1) 82:2		tasks (1) 65:13	testimony (1) 29:16	times (6) 7:21;36:3,10,13; 54:10;80:1
Street (1) 5:17		taught (3) 46:22;47:6,12	testing (20) 8:5,8;37:19;46:6,10, 11;48:8,11;57:3;58:6; 59:12,24;60:9,13,15; 61:20;64:18;80:8;85:4, 6	tiny (3) 28:14,25;69:21
strength (1) 33:22		technique (2) 24:18;54:23		tissue (7) 61:3,7;68:16,19,21, 22;70:6
stress (7) 9:12,14,17;10:1,2; 33:16;35:10	tables (2) 8:9,22	technology (1) 65:12	tests (2) 46:19;65:10	titled (1) 70:24
student (1) 54:24	talk (4) 11:22;39:11,12,13	telescope (2) 59:12,23	texts (2)	today (2) 5:18;6:19
students (1) 54:16	talked (1) 48:25	telling (1) 39:22		together (4) 10:16;44:6;45:11,13
student's (1)		temp (1)		

told (4) 47:14;84:19,20,25	75:20	21:6,6,7;29:14;42:3	46:7;47:8,15;48:4; 50:23;52:13,15;70:3; 79:20;80:15;81:5,20; 82:16	65:4
tolerate (1) 61:20	turns (2) 20:15;21:5	upper (18) 12:10,17,18;13:8,13, 16;14:24;15:2,11,13, 16;17:2,21;19:15,18; 20:18,25;75:21	validation (2) 48:8,12	virtual (4) 43:12,14,17;47:16
took (1) 54:7	twice (1) 79:1	ups (1) 10:14	valuable (25) 56:10,18,21,23;57:2, 19;58:2,4,15,16,17,18, 24;59:4,16,19,25;60:3, 18,21,23;61:10;68:6, 15,22	visible (1) 37:21
top (15) 11:23;16:8;24:24,25; 32:16;45:16;49:1,8; 52:22;59:14;63:8; 66:15,17;75:22;77:16	two (21) 6:19;11:9,15,22; 13:9,12,24;15:10,14; 18:1,3;22:2;43:7; 44:22;46:25;49:25; 50:16;51:21;62:4; 78:22;83:18	usage (1) 27:2	value (7) 34:2;56:24;57:1,9, 15;65:21;67:7	visual (3) 38:11,20,24
topping (5) 66:9,11,14,19,21	two-sided (4) 42:25;46:4,7;48:4	use (40) 10:20,24;13:9;17:3, 21;18:1;19:15;27:7; 29:6;31:9;33:6;37:2,5; 41:16;46:22;47:8,14; 48:13,16,20;49:9,14; 53:13,15,21,23;54:23; 64:2,8,11,12,13,20; 66:25;68:3;69:11; 72:13,17;74:1;82:15	values (4) 8:9;15:17;33:24; 56:20	visually (2) 37:22;38:5
touches (1) 24:24	type (3) 56:4;73:22;78:6	used (31) 8:10;11:7;13:2,12, 14,16;17:9;18:3;19:15; 25:24;27:8;32:23; 43:19;46:8;48:8;51:13; 54:2,23;55:25;56:1,2, 11,21;63:16;64:20; 67:21;68:9;71:10;73:2, 23;76:9	valve (1) 67:14	voice (1) 6:1
tough (1) 61:14	types (2) 10:3,5	useful (4) 25:2,3;55:14;73:20	vapor (5) 50:24;51:1,12;52:1, 22	volume (4) 79:20,21,23;81:8
trade (1) 71:24	typically (1) 43:19	user (6) 56:20;61:12,16; 62:24;64:3;68:6	vaporize (1) 51:8	W
trained (2) 8:2;9:7	typo (1) 18:18	users (8) 63:10,18,24;64:4; 65:4,9,12;68:2	variable (6) 14:6;53:13,15,24; 54:2;55:25	wait (1) 75:12
transcript (1) 51:11	U	uses (6) 63:13;64:6,8;68:18; 72:10;79:10	variation (1) 23:25	walked (1) 39:24
transfer (4) 13:24;14:4;48:2; 54:16	uncomfortable (1) 17:1	using (7) 19:18;20:18;24:18; 36:24;48:20;63:25; 67:1	varies (1) 24:6	wall (47) 11:18,20,21,24,25; 12:1,6;13:19,20;14:3, 12;16:8;17:12,16,19, 24;18:8,8,17,18,21,21, 22;19:1,3,5,9,9,10,10, 13,20,25;20:2,4,6,9,24, 24,25;21:2;22:17;24:4, 5,25;35:2;80:7
transporting (1) 37:3	under (6) 6:12;68:12;71:23; 72:24;78:11;79:3	usually (2) 36:18;41:9	vary (1) 29:8	walls (1) 84:6
trap (2) 64:10,25	underneath (1) 38:17	utilize (1) 63:22	vendor (1) 36:17	wants (1) 56:20
trapped (2) 42:24;43:6	understood (3) 51:5;65:14,21	utilizes (1) 64:5	vent (1) 81:17	warm (4) 24:4;31:19;82:4,5
travel (1) 38:1	unfortunately (1) 84:12	utilizing (2) 64:16,18	vented (1) 80:16	warmed (7) 9:5;31:23;52:14; 79:16;81:15,18;83:11
triangles (1) 75:21	uniform (4) 10:7,12,12;20:22	vacuum (37) 13:23;19:11,12; 22:16,25;23:9,14; 41:14,15,17,19,21,22, 25;42:10,12,19,25; 43:8,9,23;44:2,10,25;	venue (1) 56:1	warm-end (2) 14:3;16:24
trouble (1) 47:4	uniformly (2) 9:15,22		verbal (1) 47:11	warmer (3) 14:18;23:24;25:7
true (4) 35:6;45:8;83:20; 84:7	uninterrupted (3) 62:14,17;65:6		verified (1) 45:17	warmest (4) 24:10,13;30:8,17
truth (5) 5:10,11,11;35:7; 81:13	Union (1) 78:9		versus (3) 10:22;27:4;33:23	warming (1) 61:21
try (3) 6:18;51:9;55:15	University (1) 60:24		vessel (8) 19:11;23:10;49:10, 11,13,14,20,23	warms (2) 32:19;85:9
trying (5) 11:22;51:5;59:18; 66:15;71:19	unless (2) 8:21;16:25		vessels (3) 43:19;47:8;65:13	washers (3) 10:24,25,25
tube (51) 11:16,17,19;12:8,10, 11,14,17;13:1,18,21; 14:1,7,9,11,11,17,18, 25;15:9;16:1,5,7; 17:23;18:20,25;19:23; 20:2,5,9,20;21:2,4; 25:16;26:24;27:17,18, 22;28:16,21;29:2; 30:15,25;31:1,17;49:6, 7,10,11,13;54:20	unnecessary (1) 7:10		via (1) 5:21	watched (1) 84:7
tubes (2) 20:5;49:5	unusual (1) 69:24		VIDEOGRAPHER (15) 5:14,15;6:7;7:2,7; 37:11,15;62:6,10; 70:12,16;75:4,7;85:13, 17	watching (1) 84:6
turn (1)	up (28) 6:18;10:25;12:23; 14:14,23;18:23;20:10; 23:23;26:25;30:15; 31:19;32:19;36:11; 38:18;45:13;51:10; 52:24;61:21;64:23; 75:8,13,22;77:10; 79:23;80:5;81:18; 82:16;83:12	V	videotaped (1) 5:24	water (8) 49:25;50:3,4,9,19, 20;67:15;72:24
	upon (5)		view (1)	way (23) 20:4;23:8;24:22; 31:9;34:9;36:12;40:12; 44:16;45:5,11;47:4; 52:18;54:8,13;55:17, 20;58:9;69:25;71:18;

IN RE PACIFIC FERTILITY
CENTER LITIGATIONFRANKLIN K. MILLER, Ph.D.
December 14, 2020

73:7;80:19,22;81:2 ways (3) 10:23;43:22;44:1 Webb (3) 59:12,23;60:22 week (1) 7:3 weekend (2) 82:5,7 weeks (2) 17:6;60:6 welcome (1) 7:21 weld (50) 10:8;21:10;22:9; 35:3;37:21;38:21,25; 39:1,4,5,6,8,9,14,15,18, 19,23;40:5,6,10,13,14, 15,16;42:25,25;43:7, 13,13,16,16,18,20,22; 44:1,17;45:2,6,6,16,17, 17;46:14,23;47:3;48:4, 8,17;49:1 welded (3) 10:7,11;45:3 welding (1) 39:25 welds (33) 36:17;37:19,22;38:8, 10,12,13,16;39:16; 41:6,8,11;43:7;44:13, 24;45:9,10,11,12,19, 25;46:4,7,8,10,15,22, 24;47:3,8,15;48:14; 65:17 What's (12) 16:15;35:19;47:12; 50:18;51:13;55:2,24; 62:20;66:11;67:7,10; 83:14 Whereas (1) 77:5 Whereupon (4) 6:12;37:13;62:8; 85:21 whole (2) 5:11;14:17 who's (2) 64:16;65:1 wide (1) 68:9 willing (1) 67:9 winter (1) 24:4 Wisconsin (1) 24:3 within (6) 16:25;17:8,8;22:12, 22;29:16 without (4) 13:7;27:3,10;61:17 witness (10)	5:9;6:8,12;18:16; 40:2;56:13;72:18;73:1; 75:15;78:21 word (7) 18:16;44:16;51:10, 13;52:2;54:7;67:8 words (3) 13:20;51:21;52:12 work (12) 44:23;52:2,3,18; 63:11,17,22,23;65:2; 74:18;79:9;82:21 worked (4) 63:12,14;65:8;68:23 workers (1) 17:1 working (5) 36:21;61:7,10;63:2,5 works (2) 24:2;79:8 world (2) 63:12;71:21 worst (3) 13:12,14;30:16 worst-case (2) 30:6;31:2 worth (2) 57:11;58:12 wrapped (1) 49:13 wraps (1) 49:8 write (2) 59:15;71:8 written (1) 18:6 wrong (6) 54:6,6,25;55:1,12,13 X x-ray (7) 40:17,18,21;41:4; 58:8,22;60:22 x-raying (2) 43:24;44:3 Y Yang (7) 70:24;71:5;72:2; 74:24;75:2,9,17 year (1) 66:6 years (5) 16:16;31:10;35:14; 59:2;69:24 Yep (1) 12:20 Z ZEMAN (19)	6:3,3,14;7:1,6,12; 18:23;37:9,18;56:14; 62:12;70:9,18;74:11; 75:2,8,17;79:13;85:12 zeolite (3) 70:25;71:19;72:3 zeolites (4) 71:17;72:1;73:22; 78:11 zero (1) 70:3 zone (1) 39:3 Zoom (1) 5:22 0 0025 (1) 77:21 0047 (1) 77:22 0064 (1) 77:5 1 1 (4) 21:11,16,17;22:8 1.68 (1) 79:13 10 (4) 32:6,6;74:2;79:3 10,000 (3) 34:1,13;35:3 10:33 (2) 37:12,13 10:45 (2) 37:14,16 100 (4) 20:13;46:17;48:22; 76:17 10th (2) 80:9;81:12 11 (10) 26:4;27:16;29:23; 30:4,15,15;32:23;34:8; 70:23;80:5 11:35 (2) 62:6,8 11:46 (2) 62:9,11 11108 (1) 5:6 11th (2) 70:10,21 12:36 (2) 85:19,22 13X (1) 78:7 14 (10) 5:1;22:10,17;23:1, 10,14;27:16,22;29:22;	30:3 14,000ths (1) 17:22 14th (2) 5:3,19 16 (5) 32:7,9,14,15,16 168 (1) 79:5 168.5 (3) 79:14,24;80:1 1-inch (1) 20:23 2 2 (10) 11:7,10;13:3,16; 17:10;18:12;21:11,16, 17;22:8 201 (1) 5:16 2020 (4) 5:1,4,19;6:23 2200 (3) 35:15,25;36:7 23,000ths (3) 28:22;29:4;33:5 25- (1) 57:12 26 (4) 30:25;31:1,4,15 26-inch (1) 32:2 273 (3) 77:3,8,16 290 (3) 14:13,18;77:10 290-some (1) 77:23 293 (1) 77:9 3 3 (3) 25:21;33:6;34:20 3.06.30 (1) 75:25 3:18-CV-01586-JSC (1) 5:23 30 (2) 23:17;25:8 300 (8) 52:24;54:11;55:11; 71:13,16;72:4,6;73:19 304 (1) 14:6 30-layer (2) 19:24;20:8 35,000ths (1) 20:12 375 (1)	5:17 3D (1) 24:16 4 4 (26) 15:18,19,20;16:16, 22;17:3;19:23;20:5; 21:15,21,21;31:9; 35:14;36:6,10,13;50:7; 52:8;56:6,11,14;63:7; 68:19;69:9,13,21 440 (3) 6:21,24;7:11 441 (2) 70:10,14 442 (3) 75:3,5,9 4's (1) 29:18 4th (10) 6:23;7:17;11:7; 13:17;17:10;25:21; 33:8;63:7;68:10;69:22 5 5 (15) 16:25;59:14;63:8; 68:10;69:9;70:22;71:2; 75:11,14,15,17;76:8, 20,21;77:13 6 6 (3) 77:9,11;81:25 629 (1) 77:14 6th (1) 37:20 7 7.23 (1) 23:12 73 (1) 77:22 77 (7) 14:17,19;31:18; 32:17;54:12;55:11; 78:3 77.3 (2) 22:15,19 78.9 (1) 71:13 78.92 (3) 75:22;76:2,4 8 808 (18)
--	---	---	--	--

21:11;22:10;26:4,14; 27:7;29:6;37:25;38:8, 14,25;40:3,24;41:3; 44:4;48:9;61:13;76:17; 79:16 808s (1) 41:3 808's (1) 25:18				
9				
9:32 (1) 5:4 9:33 (1) 5:19 94 (2) 79:24;80:1 94111 (1) 5:18 95 (1) 76:25 9th (2) 80:8;81:12				